



Wise Use of Floodplains

LIFE ENVIRONMENT PROJECT

A review of 12 WWF River Restoration Projects across Europe

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WWF - European Freshwater Programme



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Overview Map of WWF Floodplain Restoration Projects in Europe

1. West Water
2. Wümme
3. Ringfurth
4. Gelderse Poort
5. Bislicher Insel
6. Rastatter Aue
7. Morava (Austria) and Morava (Slovakia)
8. Regelsbrunner Au
9. Danube Delta
10. Cap de Terme Canal
11. Biebrza

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“Von den Geheimnissen des Flusses aber sah Siddaharta heute nur eines, das ergriff seine Seele. Er sah: dies Wasser lief und lief, immerzu lief es, und war doch immer da, war immer und allzeit dasselbe und doch jeden Augenblick neu!”

Hermann Hesse in Siddharta.

1. Introduction

There is a growing awareness of the need for freshwater protection in Europe. Rivers no longer serve only for direct uses such as transport, disposal, water and food supply, but they are increasingly recognised for their ecological functions and prized as precious features of our heritage.

There are enormous benefits to be gained from increasing protection, wise use and restoration towards more natural river systems, which has been anticipated also in the creation of the European Centre for River Restoration (ECRR). WWF took up this challenge several years ago and developed a set of river restoration projects all over Europe, which contribute to the European Freshwater Programme. Many more river conservation and restoration projects are planned.

This study was carried out as part of the "Wise Use of Floodplains" project led by BirdLife International and supported by the EU Life- Environment Programme. It was coordinated and supported by the WWF European Freshwater Programme and supervised by the WWF Germany Floodplain Institute in Rastatt. The study tries to summarise the experiences gained from many different WWF river restoration projects across Europe. In particular it addresses the following questions: What are the lessons learned in planning, implementing and constructing river restoration? What role does WWF play? Who are the main partners? What are the ecological, social and economic benefits of the wise use of rivers? What and where are the major constraints to river restoration in Europe?

2. Case Studies

2.1 Selection and Introduction

From the 71 currently known WWF river restoration projects in Europe, 12 projects have been chosen for a more detailed analysis and evaluation. Only those projects, which already had some restoration history and experiences, have been considered. Projects still in the planning stages were not part of this study. Table 2.1 lists the start date and the means for evaluation of these projects.

Table 2.1: List of case study projects and means of evaluation

Project	Start date of restoration	Type	Means of evaluation
Danube Delta (RO)	1994	Delta	Interview, Literature, Questionnaire
Regelsbrunner Au (Danube) (A)	1996	Forest	Site Visit, Interview, Literature, Questionnaire
Gelderse Poort (Rhine) (NL)	1993	Near Delta	Site Visit, Interview, Literature, Questionnaire
Bislicher Insel (Rhine) (D)	1992	Grassland/Forest	Site Visit, Interview, Literature, Questionnaire
Rastatter Aue (Rhine) (D)	1985	Forest	Site Visit, Interview, Literature, Questionnaire
Morava (A)	1998	Forest	Site Visit, Interview, Literature, Questionnaire
Morava (SL)	1996	Grassland /Forest	Interview, Questionnaire
Biebrza (PL)	1993	Mixed Fen	Site Visit, Interview, Literature, Questionnaire
Wümme (D)	1988	Grassland	Site Visit, Interview, Literature, Questionnaire
West Water (Scotland)	1997	Grassland/Plantations	Site Visit, Interview, Literature, Questionnaire
Ringfurth (Elbe) (D)	1995	Forest	Interview
Cap de Terme (ES)	1997	Plantations	Interview

The selection criteria for the projects were regional coverage, size and type of river, type of approach chosen, degree of WWF involvement, time and degree of restoration, implementation of monitoring, flexibility of response to actual flooding and other constraints. A database of approximately 70 WWF projects is in preparation. The structure and first data are attached to this report (see Annex).

There were ample WWF projects across Europe to select from. The 12 selected projects represent a regional coverage of 8 different rivers and 8 different countries in central, south-east and western Europe. There are only a small number of projects in south-west Europe, all in a very early stage of implementation, so these have not been included in this study. Only north and most of eastern Europe are obviously lacking projects, which reflects the situation in Scandinavia and eastern Europe and the different priorities for nature conservation there. The rivers considered include two of the largest rivers in Europe: the Danube (with two projects) and the Rhine (with three projects). All the other projects are situated on medium sized rivers, or small streams.

The selected projects also seem to represent the whole range of measures and different approaches chosen. A wide range of habitats, including large rivers (Danube and Rhine), deltas (Danube and Rhine), upper and lower reaches, forested and cultivated floodplains are represented by the selection. There is an obvious lack of projects in mountainous areas, which have not yet been considered for restoration by WWF. Only the small West Water upland stream has some mountainous elements and is included. Some larger alpine rivers, such as the Drava are under consideration by WWF Austria, but this is still in the planning stage.

The selection also offers the opportunity to compare a few projects along national or country borders with different legal frameworks, approaches and administrative organisations - such as the Morava between Austria and the Czech Republic, the Rhine at Bislicher Insel (D) and Gelderse Poort (NL) and Wümme between the German Länder Bremen and Niedersachsen.

The Regelsbrunner Au project is probably the largest ecological river restoration enterprise in Europe and possibly beyond. As in the Rastatter Aue and the Morava projects the restoration emphasis is on opening the river into the floodplain and enhancing natural processes. The Danube Delta is the only Delta project. The Gelderse Poort project does not really represent the delta, although very close to the Rhine delta the river divides into three different branches and shows the hydrological and sedimentation characteristics of a delta. Wümmewiesen, Biebrza, Ammarnäs (not reviewed in this study) and partly Bislicher Insel represent floodplain areas, with a mainly open landscape character. These projects only marginally promote the need of natural dynamics and succession.

Another criterion used to select case study sites was the date of the restoration. The oldest project dates back 11 years (Wümme) while some only implemented their first measures as recently as 1998 (Regelsbrunner Au, Morava). Only a few projects can be evaluated using results from substantial monitoring over a period of years.

There are contrasting approaches, for example comparing young initiatives like the UK Wild Rivers projects and the more established Green Danube initiative.

There are certainly many more restoration projects which fulfil the criteria mentioned above, but time and scope of the study demand a limitation to those listed in Table 2.1 and the choice has also been of practical nature. In the following case study reports, each one has a different emphasis according to their specialty (e.g. monitoring, engineering, forestry, approach, partnership and others) and hence they vary in structure and length. The first ten projects have been investigated in more detail. The other two projects (Ringfurth (Elbe) and Cap de Terme) were only added as they provide additional information, but they have not been studied in detail.

2.2. Case Studies

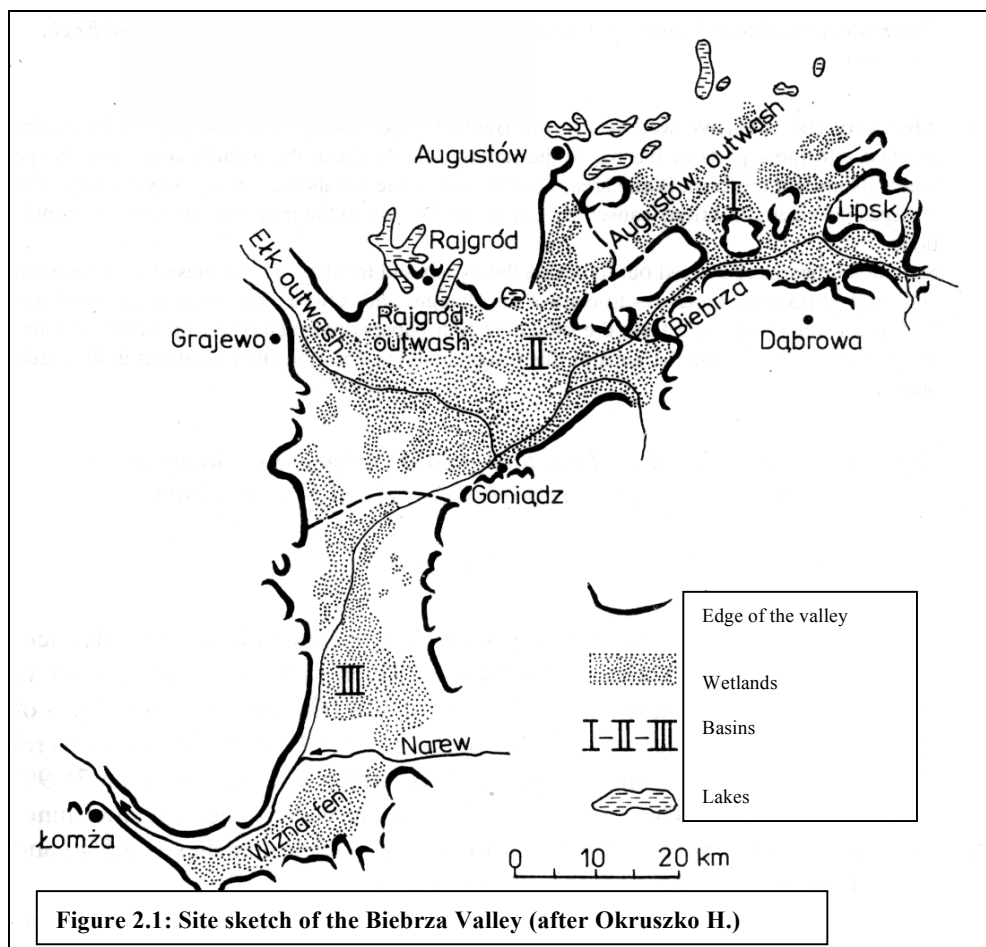
2.2.1 Water regime restoration at Biebrza National Park (Poland)

Written by Tomasz Okruszko and Przemyslaw Nawrocki

Background Information

The Biebrza Wetlands occupy a depression of the ice marginal valley in the north-eastern part of Poland, which spans an area 100 km long and 10 to 30 km wide. The actual wetlands occupy 116,000 ha of this area.

The ice marginal valley of the Biebrza river can be divided into three distinct units or basins: Upper, Middle and Lower Basin (see Figure 2.1).



The Upper Biebrza Basin consists of 40 km of a relatively narrow (1 to 3 km wide) band of the Biebrza Valley. The flat surface of the valley is filled with peat deposits of between 3 and 6 meters depth. The valley's peat growth indicates intensive alimentionation of peatland by underground runoff. There are two fully developed ecosystems characteristic of the Upper Basin: sedge moss fens and mesotrophic, wet forests.

At the point where the Brzozowka River joints Biebrza, the narrow Upper Basin expands into the Middle Basin: a section of the valley spanning an area 40 km long and up to 20 km wide. The Middle Basin is almost totally surrounded by upland levels and occupied mainly by the flood terraces of Biebrza and its tributaries: Elk and Jegrznia. These terraces comprise of peat deposits of between 1 to 3m thickness. The natural ecosystems of Middle Basin are represented by boggy peatland called Czerwone Bagno, and riverside ecosystems along the Biebrza River.

The Lower Biebrza Basin forms a longitudinally running trough, 30 km long and 12 to 15 km wide. The basin lies 12m below the surrounding upland, thus its edges are distinctly outlined, particularly on the western side. The largest area of the Lower Basin is occupied by a flood terrace made of extensive flat peatland and a 2 km wide mud channel zone. The peat depth in this basin typically reaches some 1.5 m, only locally exceeding 2 m; the mud belt consists of mud-peat and mud formation.

The high ecological value of the Lower Basin results from the zoned distribution of the fen and swamp ecosystems along the river. There are five zones usually described as: the zone of reed sweetgrass communities (*Glyceria maxima*), with old riverbeds overgrown with reedswamp vegetation; the zone of extensive tall sedges; moss-sedge zone; sedge-moss zone and alder swamp zone.

Human Impact

For centuries the Biebrza Wetlands formed a natural state frontier, protected by a ban on the draining of wetlands. However, Biebrza has also been subject to the impact of engineering work and agricultural activity.

The first major changes in the river network took place at the beginning of the 19th century, with the construction of the Augustowski Channel, designed to serve as a grain and timber transport waterway to the Baltic ports. Training works on the lower and middle courses of Biebrza (up to Netta River where Augustowski Channels starts) also took place at that time, but political and economic changes meant that the Augustowski channel was only used as a waterway for a limited time. Thus, the changes in Biebrza's riverbed also diminished.

The construction works in the Middle Basin had far bigger consequences. After the big famine of 1846, the Russian Tsar government (Poland was under partition at this time) organised public works in order to bring some of the wetlands under cultivation and quickly raise an income for the starving population. As a result of this decision, two main channels (Rudzki and Woznawiejski) and a couple of smaller ones were created.

The digging of the Rudzki Channel greatly transformed the south-western part of the Middle Basin, taking over all the water in the lower section of the Biebrza's tributary – the Elk River. The Rudzki Channel, which was to create a new bed for the Elk River, was much steeper and shorter than original lower Elk River fragment. The remaining original Elk river bed, in the area between the beginning of the Rudzki Channel and Jęgrznia River mouth, gradually disappeared with the lack of water flow.

The subsequent channel – the Woznawiejski, which proceeds along the chord of the bend formed by the Jęgrznia and Elk rivers (often called as a "Triangle" area) gradually took the majority of Jęgrznia waters, which led to the overgrowth and dying away of the Jęgrznia's river bed. A new, artificial catchment was created between the Jęgrznia and Elk rivers, as a consequence of these engineering works. Increased drainage caused by these relatively steep channels dries out adjoining areas during the summer, and does not allow for flooding during the snow-melt period. The peat forming process has ceased and instead there is "moorshing" - mineralisation of the peat layer. These processes were accentuated by the construction of two smaller channels: the Leg and Kapicki in the southern part of the Middle Basin.

More recently, changes in the hydrographic network have taken place in the north-western part of the Middle Basin, resulting from land reclamation work carried out in between 1933 to 1939 and after the Second World War. The basic channel for this area, the Kuwasy Channel, drains the area and uses the water of Rajgrodzkie Lake for irrigation. (20 000 000 cm of useful storage).

In the post-war period, the reclamation works in the Upper and Lower Basins were concentrated along the tributaries of the Biebrza river. This was done by digging small drainage ditches and the formation of drainage canals out of the small streams such as the Nurka, Niedzwiedzica, Kosodka or Brzozowka Rivers. Most of these works were carried out in the early 1960's.

In the Lower Basin the drainage systems are not very efficient, since Biebrza's riverbed remains a near natural form. In 1947 and 1974, research and design studies were undertaken in preparation of a major drainage works, with the intention to turn the Biebrza wetlands into a gigantic state farm. However, the implementation of this scheme was hampered by significant economic difficulties. At the same time in the 1960's, Polish scientists from various fields and nature conservation-oriented NGOs raised concerns about the need to preserve this unique wetland ecosystem in the form of a National Park. After more than 20 years, their efforts ended with success; in 1993, with help from WWF, the Biebrza National Park was created, protecting almost 60 thousand hectares of open fens and various types of forests.

In nature conservation terms, Biebrza National Park (BNP) is internationally significant because of its relatively well preserved hydrological system and high diversity of wetland habitats. It also supports unusually large tracts of open fen plant communities (*Magnocaricion*), not typical for Central and Western Europe. BNP's wildlife is also rich; about 500 moose (*Alces alces*) live there, at least two packs of wolves (*Canis lupus*) and numerous beavers (*Castor fiber*) and otters (*Lutra lutra*). It supports a varied community of birds; a population of breeding bitterns (*Botaurus stellaris*) of approximately 120 pairs; approximately 20 pairs of black stork (*Ciconia nigra*), spotted eagle (*Aquila clanga*), and the lesser spotted eagle (*Aquila pomarina*); 80 pairs of Montagu's harrier (*Circus pygargus*), 1200 pairs of corncrake (*Crex crex*), 400 displaying males of great snipe (*Gallinago media*) and up to 3000 pairs of white-winged black tern (*Chlidonias leucopterus*). BNP is the most important legally protected breeding ground for the aquatic warbler (*Acrocephalus paludicola*) within its geographical range, with a population of 2,000 singing males.

Need for Restoration

There is a common agreement between scientists and nature conservationists, that the Middle Basin is a high priority for ecological restoration work in BNP and its surroundings. This is because the drainage channels in this area had serious consequences on the integrity of wetland habitat.

Plant communities of peatland in the succession phase, have formed a succession link that comprises purple moorgrass (*Molinia caerulea*), meadows of different kinds and willow (*Salix* spp.) and birch (*Betula* spp.) brush developing in the direction of nettle-birch stands. The latest leads to the soil degradation associated with the intensive nitrogen release to the ground and surface waters. During the summer, groundwater levels drop up to 1 meter below the surface, degrading the soil and causing a fire hazard. The biggest fire, which took place in 1992, affected an area of 3000 ha.

The regular mowing and use of potassium fertilisers in these areas protects the soil and has led to managed meadow ecosystems. The ecological value of these systems depends on the relative intensity of agricultural practices (e.g. time of first mowing) and varies significantly from place to place.

The restoration plans for the Middle Basin depend on the complex issues of multiple land use and ownership in an area which should be considered as one hydrological management unit. For example, valuable ecosystems are beside degraded ones, and regularly mowed and fertilised plots border abandoned ones. The land is partially owned by farmers and the state. According to the protection status, the majority of the target area is designated as a National Park with the remaining peripheral parts serving as a buffer zone for BNP, or as agricultural land with no conservation status. Part of the area under BNP jurisdiction comprises both state-owned and private land, and parts of the target area outside BNP's limits fall under the State Forestry administration.

A proposal to dam the drainage canals and restore the former water conditions would face strong opposition and protest from the local people, who to some extent rely on the extensive agriculture in the area. Thus, the restoration plan for this area must aim to both increase the environmental quality and gain local society approval for this action.

Restoration Project

The main issues raised in the of the restoration project's preparatory phase were:

- Who should conduct this job, taking into account the complicated structure of land ownership and management, some legal limitations and "carrying capacity" of institutions and organisations involved?
- How to approach planning of the water regime restoration?

It was decided in 1999, by the organisations concerned, that a local NGO, Workshop Of Living Architecture was in the best position to lead the restoration project.

The technical details of the restoration project were analysed in several scientific studies conducted in this area since the late 1980's. One of these studies was funded by WWF. Most of the results were based on the extensive study and modelling of surface and ground water systems. Specialists from different Polish and foreign research institutions had analysed several options for raising the ground water table in the region. The measures considered were:

- Decreasing the flow in Woznawiejski Channel by building small dams,
- Constructing the weir by Kuligi controlling the division ratio of water flowing to Jegrznia and Woznawiejski Channel,
- Increasing the spring flood by relies of water from Rajgrodzkie Lake;
- Restoration of flows in Dead Elk using water from Kuwasy Channel,
- Restoration of flows in Dead Elk using water from Elk River and diminishing flows in Rudzki Channel.

The question of how these technical measures change the ecosystems initiated much discussion regarding the desired ecosystems in the restoration area. This was also complicated by the interest of the farmers in the different management options. As a consequence of this debate, the planning approach of the restoration project has been changed, to consider the ecological and social aspects before the technical measures.

As a result, preparation of restoration project is now seen as a process to be carried out by three groups of specialists; ecologists, sociologists and technicians, whose work should be cross-correlated (see Figure 2.2).

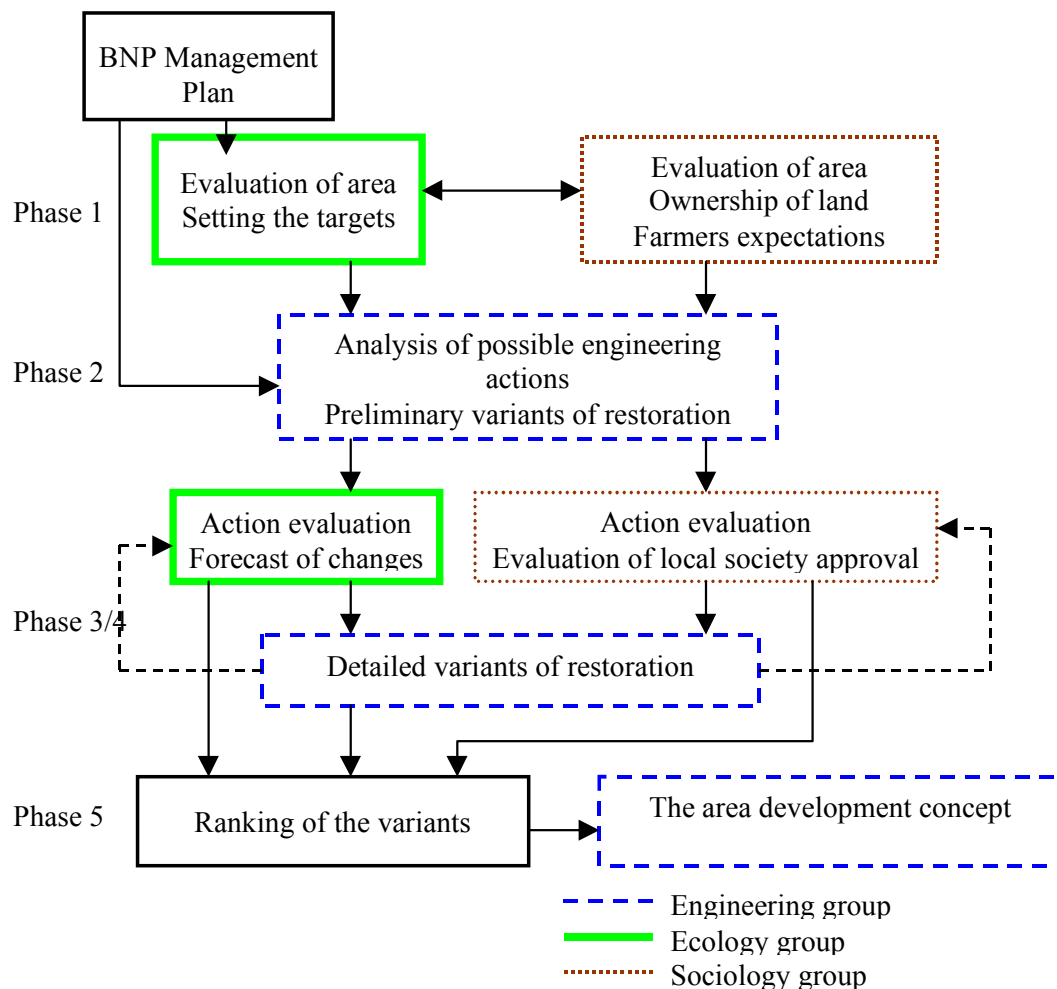


Figure 2.2: The outlines of the project's development scheme.

The restoration project area is about 15, 000 ha (see Figure 2.3) and can be divided in the three major regions:

- The “Triangle” area (delimited by Jegrznia River, Woznawiejski Channel and Elk River) which belongs to BNP. This area has been carefully considered under the framework of the BNP Management Plan. The farmers who own the hay meadows in the area have the ability to obstruct nature conservation activities.
- The valley of the Dead Elk, which is located partly in the buffer zone of the Park. The changes in the hydrographic network in this area will potentially bring the biggest increase in natural values, with a simultaneous decrease in agricultural hay meadows in current use). This area has been only undergone a preliminary investigation for its nature values.
- Fields along Rudzki Channel, which are intensively used as hay meadows. The agricultural character of this area will remain after the changes, but water conditions will be affected by changes in upper course of the Rudzki Channel. In order to gain acceptance by the local community, this impact should be diminished by building appropriate hydraulic structures.

An “area development concept”, will be finalised in 2000 and this will conclude the preliminary analysis of restoration options and officially start the process of infrastructure design, followed by project implementation. The “area development concept” will then require approval by the local voivodeship authorities, before the design and implementation processes can start.

The restoration project is a joint venture of Workshop of Living Architecture, BNP and WWF. The funding for preparing the “area development concept” will be provided by WWF and EkoFund (Polish financial institution co-ordinating eco-conversion of Poland's debts). The experts involved are recruited from BNP staff and various Polish scientific institutions (some of the experts were members of the team preparing the original Management Plan for BNP.)

Conclusions

The restoration project of the Biebrza Valley Middle Basin has a long historical record. The first proposals to change the area were prepared in late 1970's, aimed at changing the soil condition in order to improve the grassland productivity. For the last decade, scientists have concluded that the environmental conditions and nature conservation needs of this area could be significantly improved by restoring the hydrological status quo of this area.

However, despite numerous reports, not much has been achieved during this time. Complicated land ownership and conservation status has created a difficult situation, reinforced by disagreement between ecologists on the specific targets in this area.

NGO activity has changed the approach and this forms the basis for a restoration project which is able to break down the barriers between farmers, nature conservationists, researchers and engineers. The only chance for success of this project is sufficient co-operation between all involved parties.

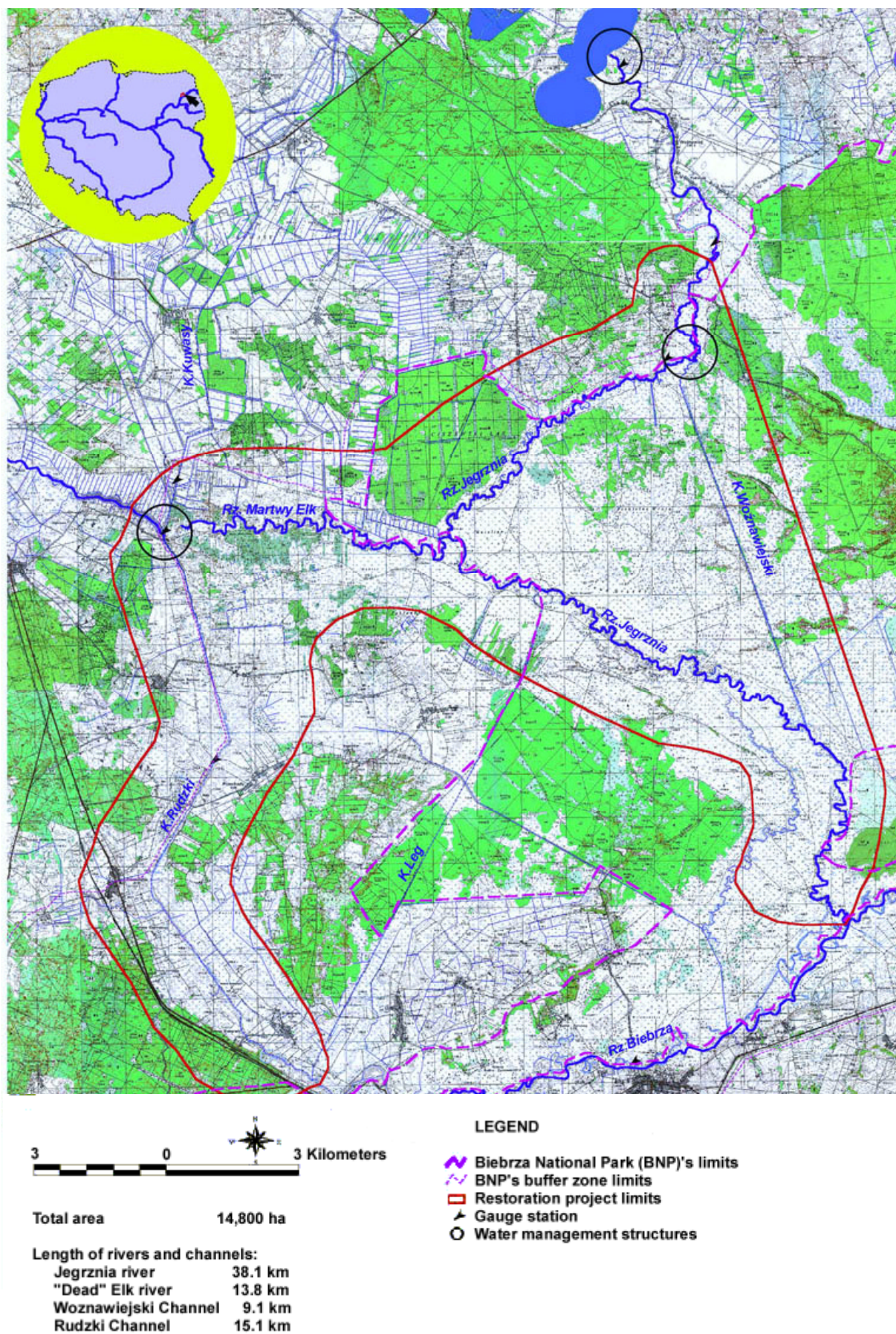


Figure 2.3: The Biebrza Restoration Project Area

2.2.2. Bislicher Insel Restoration Project

Description and Context

Location

River Rhine, in the west of Germany, near to the Dutch border. 6°30'E, 51°39'N. See map (Figure 2.4).



Background

In the lower Rhine floodplain between the towns of Xanten and Wesel (Federal State of North Rhine-Westphalia), is situated the 1,200 ha of the “Bislicher Insel” project area.

From B.C. until mediaeval times the River Rhine ran between Xanten and Wesel more or less along the same route as today. At around 1200 A.D. the main branch of the river changed its course southwards and created a growing meander. By 1750 A.D. the riverbed had changed its course by more than 3km to the south and destroyed the settlement called Beek (once) and the village of Birten (several times). During the 18th century, the river started to create a second meander near Wesel and endangered the important fortress in front of the town. In 1786 Friedrich the Great ordered the construction of a channel of about 10 km in length between Wesel and Xanten, the so-called 'Wesel-Channel', in order to direct some of the high-water masses of the Rhine, so as to protect his fortress and the village of Birten. After the channel was finished around 1795, the great flood of 1799 made this channel the main river course. The area between the two branches was called “Bislicher Insel”, because it was an island (=Insel) belonging to the village of Bislich. Due to sedimentation, the old river course filled up in the upper parts from 1799 onwards, and since about 1825 has only flooded during high water events. The lower parts remained open until the end of the 19th century, whereas the middle part still remains with open-water to date, connected by a small channel to the River Rhine. At present, the Bislicher Insel is managed as a summer polder, protected with low dykes against average high-water events during the summer. During the winter or in the case of high floods, the whole area is flooded. During a high-water event the area is flooded along the downstream remnant of the old riverbed and the water leaves the Bislicher Insel on the same remnant after the Rhine water has dropped again, depositing a considerable amount of nutritious sediment in the process.

Further canalization of the River Rhine and dyke building nearer to the riverside lead to a steeper gradient and an increased run off speed of the water. This resulted in a constant and considerable deepening of the riverbed, still ongoing today. This development was strongly supported by the intensification of ship transport on the river. The increasing number of motorised ships, steadily increasing in size and motor power, disturbs and turns over the sediments of the river bottom, which are subsequently transported away by the river water. Due to this deepening, the groundwater level of

the surrounding land also decreased, which has led to the drying out of formerly wet areas near the bank, noticeable up to several kilometers from the riverbank.

By 1926, early conservationists were fighting bitterly against the first plans to extract the gravel in the southern part of the Bislicher Insel. But first attempts to legally protect the area failed, and it was not until August 1940 that a part of the area was designated as a nature reserve. Outside the nature reserve, gravel extraction continued until the end of the 1960s, which left behind a richly structured mosaic of relatively flat lakes, not deeper than 3-5 metres.

In 1954, new threats became prominent, when plans were discussed to dry out the oxbow lake to get access to ammunition dumped there at the end of the Second World War by German troops. Eventually it was decided to access the ammunition with the help of divers.

A turning point was reached in 1982 as a result of a WWF initiative (especially the former WWF-Naturschutzstelle WEST), in collaboration with other local and regional NGOs. A major political change in attitude towards the use of the floodplain was achieved.

Habitats

The area is mainly grassland and arable land with scattered stands of hybrid poplars, which have been gradually replaced by natural succession. The watercourse is part of an old 'river arm', disconnected from the river in the last century, and some lakes are present due to former extraction work, covering about 20% of the area.

Biodiversity

Table 2.3: Key species of the Bislicher Insel project

Taxonomic Group	Species
Aquatic Flora	13 spp. red listed, e.g. <i>Nymphoides peltata</i> , <i>Potamogetum lucens</i> , <i>P. pusillus</i> , <i>Ranunculus circinatus</i> , <i>Tolypela prolifera</i> .
Terrestrial Flora	321 spp. 48 red listed e.g. <i>Salvia pratensis</i> , <i>Primula verus</i> , <i>Briza media</i> , <i>Butomus umbellatus</i> , <i>Inula britannica</i> , <i>Centaureum pulchellum</i> , <i>Eleocharis acicularis</i> , <i>Peplis portula</i> , <i>Populus nigra</i> , <i>Ribes nigrum</i> , <i>Senecio paludosus</i> , <i>Ulmus minor</i> .
Invertebrates	Odonata: 21 spp., 5 spp. Regionally and 4 nationally red listed: <i>Anax imperator</i> , <i>Orthetrum cancellatum</i> , <i>Cercion lindeni</i> , <i>Lestes barbarus</i> . Lepidoptera: 173 spp., 20 spp. regionally and 4 nationally red listed, e.g. <i>Orthosia miniosa</i> . Orthoptera: 12 spp., 4 spp. Regionally and 1 nationally red listed: e.g. <i>Conocephalus dorsalis</i> , <i>Mecosthetus grossus</i> . Carabid Beetles: 58 spp., 7 nationally red listed. Molluscs: 36 spp. 6 water snails and one bivalve are nationally red listed: <i>Unio</i> spp. strong decrease due to increasing waste water discharge and sedimentation due to the lack of streaming of the main water.
Fish	22 spp., 9 spp. Red listed spp. <i>Rhodeus sericeus amarus</i> , <i>Cobitis taenia</i> , <i>Gasterosteus aculeatus</i> , <i>Carassius carassius</i> , <i>Leucaspis delineatus</i> , <i>Scardinius erythrophthalmus</i> , <i>Gymnocephalus cernuus</i> , <i>Misgurnus fossilis</i> , <i>Lota lota</i> .
Reptiles/ Amphibians	6 species, two regionally red listed: Natterjack Toad <i>Bufo calamita</i> and Great-crested Newt <i>Triturus cristatus</i> .
Birds	192 spp in total. Breeding Birds: 94 spp breeding: e.g. Heron <i>Ardea cinerea</i> , Cormorant <i>Phalacrocorax carbo</i> , Garganey <i>Anas querquedula</i> , Black-tailed Godwit <i>Limosa limosa</i> , Nightingale <i>Luscinia megarhyncha</i> .
Mammals	24 species, including 3 nationally red listed: Harvest Mouse <i>Micromys minutus</i> , Polecat <i>Putorius putorius</i> , Pipistrelle Bat <i>Pipistrellus pipistrellus</i> .

Land Use

The main land use in the lower Rhine floodplain is agriculture. In recent years there has been a considerable decline in biodiversity due to intensive agricultural practices. Forestry does not play an important role; there are only a very few remnants of natural floodplain forest and some small poplar plantations. Hence the natural habitats of the floodplain forest are very much restricted over large areas.

The decision, in 1992, to further extract salt below the project area has been heavily criticized. The extraction rights allow the production until 2025. This mining activity leads to a considerable lowering of the land surface. A decrease of up to 4m has been predicted for the southern and western part of the project area. This has important implications for future measures, such as building works and in particular for dyke building.

As salt mining still continues, the application made in 1993 to extract gravel from the area was rejected citing the argument of irreversible damage for nature and biodiversity. Gravel extraction is still an important usage of adjacent areas.

The area is constantly in danger of severe flooding, so flood control is an important issue for the local population. Dyke building as close as possible to the embankment was and still is the strategy to protect local settlements, but also agricultural areas. The dyke near the project area is recognized as a

weak point and plans to improve the situation by reinforcing the dyke near the embankment will lead to considerable damage of the restoration project area. Conflicts between the needs of flood control and nature conservation can be solved, with a solution of reconstructing the main dyke at a distance from the river, to give it space to flood. This would provide crucial benefits for nature, within a naturally flooding dynamic system.

Eventually, the government of North Rhine-Westphalia decided to build the dyke at some distance from the Rhine and keep the Bislicher Insel as a natural floodplain. Against this decision, some landowners went to court. The decision of the court is expected in autumn 2000. If the court decides in favor of the government, the construction of the new dyke will begin.

Water abstraction for potable water use is planned in the eastern part of the area; this could lead to unwanted groundwater decrease.

The area was also used as a resort for recreation. Until the beginning of the 1990s, there were two camping sites in the area, often with several thousand permanent caravans. These sites were removed in the scope of nature conservation management, but recreation remains a threat to the site. Because the Bislicher Insel is one of the most well known nature reserves in the region, and as the Ruhrgebiet (with its dense population) is nearby, there are still problems with the great number of visitors. One of the main problems is that they do not stay on the few roads, but also recreate in sensitive areas. In severe winters many people use the area for ice skating, with the possibility of damage to the vegetation.

There are a few houses scattered over the area, mainly in the northern part, and hunting and fishing is still practised in part of the area.

Ownership

About a quarter of the project area is owned by the Kommunalverband Ruhrgebiet KVR, as the receiver of the federal funding for this project of national importance. A further quarter is owned by the federal state (Land) of North Rhine-Westphalia and some percentage by the Federal Republic of Germany. Altogether, currently about half of the project area is owned by governmental institutions.

Protection

About three-quarters (900ha) of the site is protected as a nature reserve. The Bislicher Insel is one of the most important wetland areas in the region, recognised by its designation as a Ramsar site and a SPA according to EU Wild Bird Directive, in 1983.

Threats

Despite all the legal protection, the site is still under severe threat from farming, recreation, hunting, fishing, and the lack of a natural hydrology. For a more detailed description of the threats see the land use section.

Restoration

Objectives (goals)

The major objective is to re-establish natural hydrological conditions on the site, but also to integrate the land use in a sound way in parts of the area. Another major objective is to replace the hybrid poplars with natural trees, such as Black Poplar *Populus nigra* and other bushes and trees, which naturally grow in the area.

Approaches

The approach is mostly a conventional one, including the purchase of the entire area. For achieving a wider acceptance, working groups with many stakeholders (e.g. farmers, fishing association, the local communities, the water authorities and the dyke board) were established, with the aim to accomplish a general agreement on the planned issues.

Activities

Land purchase first started in 1982. By 1995, 50% of the Bislicher Insel project area had been purchased.

The first activities in the floodplain included the creation of small temporary ponds and the removal of plantations of hybrid poplars. In the years 1982-85 grazing was gradually reduced from most parts of the area to encourage reed belts to develop near the river embankment and to promote natural succession on drier areas. Target species have been Bitterns *Botaurus stellaris* and Marsh Harriers *Circus aeruginosus*, among others. Reed cutting was still permitted.

In 1990, the two camp sites (mostly illegally established in the area and frequently flooded by the winter flooding) were totally removed. More than 2,600 permanent caravans were removed in total.

Hunting was prohibited in an area of more than 200ha late in the 1990s and fishing has been almost completely excluded.

Until 1992, a large site of extensive grassland was used for breeding Drakehner Horses. This activity was stopped, and this land (together with about 60ha of maize fields) has been converted into a zone of natural succession. Part of the area (40ha) has been rented out for extensive grazing by a herd of 20 Hereford Cattle. A major road has been closed and several others were redesigned to calm the traffic in the area.

Organisational and Legal Framework and Management

WWF has been working in the area since 1982 and its active lobbying initiated a large project with federal and country funding support. In 1982, the Kommunalverband Ruhrgebiet (a regional association of municipalities) successfully applied for federal funding to support this project. The Kommunalverband Ruhrgebiet started to purchase larger parts of the area and a management plan was designed and signed in 1995, after receiving a second phase of federal funding. The management plan is the legal basis for all currently implemented and further planned restoration work.

Together with other regional NGO's, WWF founded the Niederrheinische Arbeitsgemeinschaft Biotopmanagement (NAB), which managed the project on behalf of the Kommunalverband. The NAB, together with WWF organised the management, including the monitoring. The monitoring should lead to the management plan becoming a legal binding instrument for the implementation of the activities to be carried out in the project area. It has to be accepted by the Land (North Rhine-Westphalia), the Federal Republic, the county Wesel, and the communities. In 1992, WWF cancelled its commitment and no longer supported or followed on the progress of the project. The NAB proceeded to work on the project under the name "Biologische Station im Kreis Wesel" with financial

support from the federal state of Nordrhein-Westfalen (North Rhine-Westphalia), KVR and the Wesel district (Kreis Wesel).

Plans to remove or reconstruct any dykes are in the responsibility of the dyke board, consisting of all landowners and the municipality. These plans need their widespread acceptance, to be implemented. Dykes planned by the dyke board, have to be confirmed and financed by the North Rhine-Westphalian government. The federal government has stated that they will only finance a dyke that keeps the Bislicher Insel as a natural floodplain.

Evaluation

Monitoring

From 1984 onwards, birds (breeding and roosting) have been monitored every year. The only other additional surveys include: vegetation, dragonflies and amphibians (once) and small mammals (twice).

Experiences

The reed belts developed quickly, which enabled many of the target species to colonise. Unfortunately the Bittern *Botaurus stellaris* has not yet returned as a breeding bird. The number of geese has increased considerably. The area has developed into one of the major night roosts and feeding sites for wintering geese in the area. During the 1980s and 1990s this site has become one of the most important areas for Bean Geese *Anser fabalis* and White-fronted Geese *Anser albifrons* in Germany. Although the trends for these species of geese have been increasing almost everywhere, the exclusion of various disturbing factors, most certainly must have led to the acceptance of the area as a quiet roosting place for several ten thousands of geese.

The prohibition of hunting and fishing led to the establishment of a Cormorant colony *Phalacrocorax carbo* (currently 200-300 pairs), which is one of the greatest inland colonies in Germany. The recovery of most wetland species is in fact slower than expected or not existing at all and species like waders are still decreasing, which is a trend observed elsewhere, and not necessarily due to a lack of sufficient restoration measures.

There have been two different ways of converting maize crops into natural vegetation. One area has been converted with support of additional planting, the other adjacent area has been set aside without any additional seeding. Surprisingly the latter grew more natural and further projects trying to convert maize crops should take these experiences into account.

Constraints

River restoration at this location is greatly driven by the economic demands of growth, the needs of the local people, and small-scale industries, that are not necessarily in alliance with the project's restoration objectives. In addition, the needs for flood control, determine the limits of the development of natural processes.

Former large-scale extractions of gravel and minerals (salt) have had a large impact on the soil structure, which again sets certain limitations to further reaching the restoration goals. The removal of summer dykes and the reconstruction of new dykes, must carefully bear in mind the changes to the soil and topography. The plan to extend the dyke further backwards inland was rejected by the dyke board, and only because the Land threatened to withdraw any financial support to the board, did the board accept the plan. Usually the Land funds 80% of dyke construction costs, but in the case of the construction of the dyke further from the river (and excluding the Bislicher Insel), the Land will cover up to 90% of the costs in this restoration. Technically, the reconstruction of a dyke along the old river course could lead to unexpected sedimentation in the new bed, with continued extraction and deepening of the old riverbed and related problems. In addition, the new position of the dyke will

encounter a depression created from former salt mining in that area. It is already visible in the topography that the land has sunk considerably.

There is still considerable suspicion among the local population against any kind of restoration, which involves the increase of any water retention area or the removal of dykes.

Ecological benefits

The establishment of a colony of cormorants and a roosting site for a large number of wintering geese clearly demonstrated the success of the activities. These ecological benefits can clearly be explained by the measures undertaken to restrict fishing in the area. The cormorants started breeding in 1991 with 7 pairs and increased in numbers every year. In 1998, 315 pairs bred in the Bislicher Insel.

Table 2.4: Status of bird species after restoration in the Bislicher Insel

Current Status	Species	No. of Breeding Pairs in 1998
Increasing numbers:	Cormorant <i>Phalacrocorax carbo</i> Gadwall <i>Anas strepera</i> Mute Swan <i>Cygnus olor</i> Sparrowhawk <i>Accipiter nisus</i> Nightingale <i>Luscinia megarhyncha</i> Whitethroat <i>Sylvia communis</i> Reed Bunting <i>Emberiza schoeniclus</i>	315 1 new! 3 2 22 17 80!
Decreasing numbers:	Black-tailed Godwit <i>Limosa limosa</i> Meadow Pipit <i>Anthus pratensis</i> Sky Lark <i>Alauda arvensis</i> Corn Bunting <i>Emberiza calandra</i> Spotted Flycatcher <i>Muscicapa striata</i> Lesser Whitethroat <i>Sylvia curruca</i>	2 10 15 2 0 2
More or less stable numbers:	Greylag Goose <i>Anser anser</i> Heron <i>Ardea cinerea</i>	8 15 Both species vary strongly between years, due to high water and weather events.

Conclusion

WWF was involved in the project from a very early stage. Its main interests and concerns focussed on the fascinating numbers of wintering geese in the area. To secure the internationally important site, WWF became involved in the project and it was WWF who initiated the site becoming one of Germany's most important Ramsar sites. WWF drew attention to the site's importance to the federal government, which substantially supported WWF's goals, providing funding in the project. But, in the late 1980s, early 1990s WWF withdrew its commitment from the project to focus more on East German and East European projects.

One of the aims of the WWF engagement in the project was to develop a border-crossing wetland between Nijmegen in the Netherlands and Duisburg in Germany, with the Bislicher Insel and the Millinger Waard (see also Gelderse Poort) as core zones. It was proposed that in Germany, in the Bislicher Insel project, WWF would initiate the project and then it would be continued to completion by other organisations/collaborations etc. There were a fair number of good arguments for this decision, but in the face of the slow development of the project, the lack of border crossing aspects, as well as the still existing problems and constraints, one might reconsider WWF's decision to withdraw from the project. It has to be noted, that all efforts of WWF Netherlands to influence the development

in Germany after the withdrawal of WWF Germany from the region were in vain and the efforts of the Netherlands administration to initiate a border-crossing co-operation for wetland protection failed.

The following comparison between two neighbouring river restoration projects of course is not to be looked at in the circumstance of the involvement of WWF alone. The situation between Germany and the Netherlands is quite different in many respects, but especially in the Bislicher Insel restoration, the involvement of an internationally acting NGO would have been very beneficial for the project.

There are three major differences between the projects at Bislicher Insel and Gelderse Poort. (Bislicher Insel, in Germany is only approximately 50km to the south-east of Gelderse Poort, in The Netherlands).

Firstly, the Dutch initiative was based on a high level agreement between all governmental bodies, all NGOs and most importantly included most stakeholders. In particular, the local small-scale clay industry has been gained as a partner in the project. In the Bislicher Insel this partnership is not possible as no clay industry exists in the area. Large-scale gravel extraction seems to be incompatible at this stage, but it is probable that no real attempts have been undertaken to start communicating with this (at present) important conflict group, to become a possible partner in the future. This issue of course is extremely relevant, and might become an important experience for many river restoration projects all over Europe, such as on the Rhine, Elbe, Danube, Oder and others.

Secondly, the conflict with the dyke building and maintaining bodies is strong and long running in the German part of the Rhine Valley. To resolve these, new strategies are needed, such as the Dutch initiative to scope the issue of flood control together with all other beneficial consequences into one big plan (such as The Ooievaar Plan in The Netherlands) for the entire basin, where the benefits to biodiversity will be a side product. In Germany, the increase of the retention area by shifting the dykes further inland is still not seen as an appropriate measure to gradually reduce the flood peaks. Crucially, opinions of the population and issues related to their property must be addressed carefully.

Thirdly, nature conservation strategies and legislation in the Netherlands and Germany are totally different. In the Netherlands strategy, potential nature reserves are bought by the state or NGOs, and subsequently developed. Such development can mean a total reconstruction of the site and to change an agricultural landscape to a semi-natural one. In Germany nature conservation is still dominated by conserving the existing landscape. In most cases, sites of interest for conservation in Germany remain in the ownership of private owners and are declared as a nature reserve by decree. Any changes in use are only possible by means of voluntary contracts between the state and the owners.

The border-crossing initiative in the Lower Rhine area, to develop semi-natural sites on both sides of the border was wrecked due to these differences. Besides, after WWF-Germany withdrew from the Bislicher Insel project, the fact that the initiative was still pushed for by the Netherlands (Government and WWF), this initiated mistrust on the German side because they believed that The Netherlands wanted to develop a “green garden” in Germany, in front of their industrial zone Nijmegen-Arnhem (see Study of Diana de Jong 1999).

Last, but not least, the success of the Gelderse Poort project seems to lie in the strategy of totally excluding any form of official farming by the local people. This sounds rather unfashionable, particularly in the face of the Agenda 21, which encourages local economies to develop sustainable methods of and approaches to land use. But, as the framework of European agricultural policy is still in favour of intensive use in floodplains, the strategy to exclude all farmers seems to be appropriate. The Bislicher Insel project tried to enhance biodiversity on wet grassland, which needs sound land use practises, but here the aims clash with the quite restricting impacts of 'true' restoration. It has to be seen in the future if the floodplain can be successfully connected to the river system.

WWF should learn from the projects along the River Rhine and combine common experiences to enforce a common strategy for the entire river.

Acknowledgements

I would like to thank Johan Mooij for guiding me through the floodplain area and for fruitful discussions.

References

Kommunalverband Ruhrgebiet (1994): Naturschutzkonzept für die Bislicher Insel. Essen 52pp.

2.2.2 Cap de Terme Canal Restoration Project

Description and Context

Location

The project is situated along the Cap de Terme Canal. Aiguamolls de l'Empordà, Gerona, north-east Spain. 3°03'E, 42°15'N.



Background

The project began 2 years ago to promote forest plantation in this naturally very dry area of north-eastern Spain. The improvement of the channel along the Cap de Terme Canal in Aiguamolls de l'Empordà Natural Park (Gerona) was only a secondary intention. This project was funded by Kellogg's and developed together with the Natural Park Service.

Restoration

Objectives

The planting of trees should help to promote the recovery of the original characteristic vegetation known for the locality, which has already disappeared from large areas. This also should help to prevent water losses, which have previously occurred due to the lack of vegetation cover, and also reduce the current increasing salinity problems in the area, by lowering the evaporative demand. The plantation should also protect the water-course from dust from nearby roads, reducing this source of sediment input. By reducing this source of sedimentation, this will prevent further drying out of the area because the water will be maintained in the system for as long as possible. There is no intention to use the planted forest in any way at all.

Activities

On a 700m stretch along the Cap de Terme Canal, trees, mainly Black Poplar *Populus nigra*, a typical floodplain tree species, have been planted in a strip of up 20m width along the canal. A private firm carried out the WWF-project.

Evaluation

Experiences

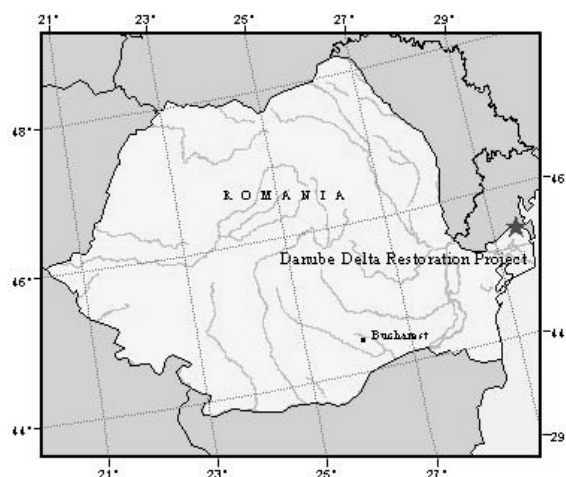
There is no knowledge of any monitoring having been set up, or any other results, other than the mention of serious weed problems in the project area. At present, the project is still too young to deliver any results.

2.2.4 Danube Delta Restoration Project

Description and Context

Location

East coast of Romania, where the River Danube flows into the Black Sea, bordering the Ukraine to the north. 29°25'E, 45°25'N (Babina) and 29°30'E, 45°24'N (Cernovca). See map (Figure 2.5).



Background

The Danube is Europe's second largest river. Covering 808,000 sq. km (which is about 8% of Europe, home for 8 million people), it is the 23rd largest basin in the world, flowing through eleven countries, starting as a trickle in the Black Forest in Germany until it terminates after 2,840 km in Europe's second largest wetland, the Danube Delta in Romania. WWF recognised the conservation value of Europe's second largest water-course and initiated two major programmes. The WWF 'Green Danube Initiative' involves five restoration projects representing all parts of the river from the upper parts in Germany, the central parts in Hungary and Bulgaria and the Danube Delta. A second more recent initiative is part of the 'Danube Carpathian Programme', which has been established since the fall of the iron curtain in Eastern Europe, and involves all countries in the lower section of the Danube.

In the nineteenth century, some measures were taken to improve navigability and support agricultural exploitation. However their impacts were relatively minor. In the 1960's a plan was developed to construct dams and a channel for the establishment of agricultural polders and silviculture. This work had a considerable impact on the Delta's complex hydrological balance, causing disruption to the delicate ecosystem. A further and more ambitious plan for agricultural intensification was drawn up in 1983. It required more drainage and the construction of additional dykes.

By the time of the political changes that took place in Eastern Europe, considerable damage had already been done to the wetland of the Danube Delta. However, under the new political climate, nature conservation swiftly gained a new impetus. In 1990, plans were already being made for the establishment of a Biosphere Reserve in the Danube Delta.

A pilot scheme was initiated under the WWF Green Danube Initiative to begin repairing some of the damage. This focused on two islands, Babina (2,200ha) and Cernovca (1,580ha), that had been surrounded by dykes. It was mainly initiated by WWF Germany's Institute for Floodplain Ecology, and drew upon their expertise. The scheme received additional funding support from the World Bank, under the GEF Programme, and the following report focuses on these activities.

Geographical Situation and Habitats

Situated at the Chilia branch of the River Danube, both islands are exposed to 58% of the sediment transport of the Danube, which has a large impact on the rate of sedimentation and the vegetation present on these islands. Due to the high level of sediments deposited, gley soils are dominating. The major part of both the islands of Babina and Cernovca (about 85-90%) were originally covered by reed areas, appearing as floating reed with scattered Grey Sallows *Salix cinerea*. The open lake waters were covered with swimming vegetation of more than ten different aquatic communities. After the dyking the vegetation changed dramatically. As a consequence of the lack of flooding, the area began to dry out, and there was an increase in soil salinity and acidity which ruderalised the reeds, becoming increasingly interspersed with *Cirsium arvense* and *Tanacetum vulgare*. Salt tolerant species, resistant to desiccation, such as *Artemisia santonicum* and *Hordeum hystris* spread on the dryer areas. On new sites various salt indicator species such as, *Sueda maritima* and others settled. Undyked islands, which can also still be found in the neighbourhood, consist of White Willow *Salix alba* brushwood developing on bare sand and sludge banks. Later succession stages contain White Poplar *Populus alba* and Tamarisks *Tamarix ramosissima* and sometimes even elements of hardwood forests.

Biodiversity

The delta is critically important for waterfowl, being situated on two major migration routes. Over 60 species of fish and 300 bird species depend on the Delta, including a major portion of the world's population of the endangered Dalmatian Pelican *Pelicanus crispus*. Various birds of prey are also inhabitants, including the globally threatened Imperial Eagle *Aquila heliaca*. Here, a large proportion of European freshwater fish species can be found, especially Cyprinids.

Invertebrates

There were no surveys of invertebrates prior to the dyking and hence no baseline data. In the summer of 1995 (the year before the restoration took place), the island of Cernovca was surveyed, and it showed a state of impoverished biodiversity, implied on both islands. It showed that particularly, there was a paucity of hydrophilic species. These species only survived in poorly remaining stands of reed in the eastern part of the island. It was now, halophilous species and species of pontic-iranian-centralasian or southern-mediterranean origin that invaded the polders. These included the Tiger Beetle *Cicindela chiloleuca* and the Halophilous Bug *Henestaris halophilus*. Only a few remnants of the former amphibic and terrestrial habitats had survived containing species like the cricket *Petronomebius concolor* and *Myrmecophilus azevorum*. In humid and open riparian zones the Large Copper *Lycaena dispar* and the Carabid beetle *Stenolophus discophorus* were present.

Fish

According to old records, made two decades before the dyking, 14 important fish species were identified. Among these, most belonged to the carp family Cyprinidae including Crucian Carp *Carassius carassius*, well adapted to fluctuating oxygen conditions. Other significant species were Pike *Esox lucius*, Red Eye Scardinius *erythrophthalmus*, Roach *Rutilus rutilus*, Catfish *Silurus glanis*, Pikefish *Stizostedion luciperca*, Orfe *Leuciscus idus*, Barbel *Barbus barbus*, Asp *Aspius aspius*, Tench *Tinca tinca*, White Bream *Blicca bjoerkna* and Perch *Perca fluviatilis*. After the dyking in 1993, fish sampling revealed just two cyprinid species, which were able to tolerate the saline conditions.

Birds

In total 325 species have been recorded in the Delta, comprising 109 breeding birds. Figures about the two islands before the dyking were not available, but it was clear that after the dyking, the avifauna composition changed drastically. 67 % of the bird species were terrestrial species, whereas almost all the aquatic and reed species disappeared.

Mammals

Only a few species were found on the islands. Among them were Otters *Lutra lutra*, Wild Boar *Sus scrofa*, Wild Cat *Felis sylvestris*, Raccoon Dog *Nyctereutes procynoides* and Roe Deer *Capreolus capreolus*. Whereas Wild Boar and Musk Rat *Ondatra zibethica* decreased in density, Roe Deer and Common Hare *Lepus europaeus* increased.

Land Use Prior to Restoration

The primary human use of the area before dyking was for fishing. Reed was also an important resource, initially harvested by hand and later, mechanically. Some harvesting of larger trees took place for firewood. Hunting of wildfowl and larger mammals was also practised to cover the needs of the local population. The only areas suitable for agriculture were the natural embankments and levees at the upstream ends of the islands.

Large-scale dyking and drainage schemes took place following the 1983 'Programme for the remodelling and integral use of the natural resources in the Danube Delta'. They were intended to facilitate large-scale agriculture, but were largely unsuccessful as they failed to take into account unsuitable soil conditions. When completed in 1990 the only possible land use was grazing by cattle, horses and a few sheep.

Hunting of the increasing deer population was an additional source of natural income. In order to increase the hunting bag, the local people set fire to the vegetation in order to prevent hiding places for the deer from developing. This had drastic consequences for the floral habitats and their associated fauna.

Current Ownership

The total area on both islands belongs to the state of Romania.

Protection

The first efforts to protect the Danube Delta began in 1990. This became concrete on 15th February 1993 when UNESCO officially recognised the Danube Delta as a Biosphere Reserve. Both islands were just outside the core zones of the reserve. On 13th May 1991 the Delta was added to the Ramsar Convention, relating to wetlands of international importance.

Threats (past and current)

The first dyking in the Danube Delta had already taken place between 1938-1940, when 3,400ha of Tataru Island were dyked. In 1983, under a decree by the Romanian government, the now restored Babina and Cernovca islands were planned to be dyked, which actually took place in 1985 and 1987, respectively. Cernovca was planned for rice growing, although analyses have now shown that the soil was unsuitable for agriculture. In order to lower the groundwater level to establish the agricultural practices, a network of drainage ditches consisting of main and secondary channels, as well as pumping stations, were constructed. Reed rhizomes were removed by means of ploughing, although this was not quite completed on Cernovca. By 1990, when the work stopped, more than 97,400ha had been dyked and about 40,000 ha were planned to be converted into agricultural land.

Inflow of water into the dykes and the exchange of sediments was interrupted. As a consequence there was a change in the hydrochemistry, and salinisation in the soils occurred. Furthermore, the delta has been increasingly exposed to heavy metals and oil pollution. Unfortunately, the war in the Balkans contributed much to this. Both the dyking and the pollution not only threatens the wildlife, but also the primary basis for the economy of more than 20,000 people living in the delta, who rely on fishing.

Restoration

Objectives (goals)

The stated objectives of the restoration work of the two islands, Babina and Cernovca are:

- Rehabilitation of the wetlands with their varied habitats and functions;
- Reestablishment and conservation of biodiversity;
- Reestablishment of natural, renewable resources for the sake of the local population.

Approaches

The approach was experimental, and hence was carried out with caution, because such largely dyked areas had never previously been reopened, and there were no previous experiences to draw knowledge from. The local organisations and administration sought a great deal of international advice. The Danube Delta Institute and WWF Floodplain Institute were the main responsible partners in the opening of both island polders. They collaborated and exchanged closely with the WWF International Green Danube Programme, other organisations like IUCN, and the Public Water Works and Water Management Flevoland-Holland, who were involved in similar projects elsewhere in the Delta. For financial support, due to the involvement of international co-operation, it seemed appropriate to apply for funds from GEF of the World Bank.

The first large-scale experiment was the opening of the dams of the Babina polder in 1994. The second step was to open the Cernovca polder. The opening of the Cernovca polder along with other polders over the wider area of the Delta should build on the experiences gained from the work started in Babina. Restoration of the hydrological dynamics is recognised as central to restoring the natural ecosystem. In line with this, the priority has been given to reopen the polders in order to promote fluctuations in the water level. Monitoring of the changes is seen as key to assessing the success of the project in the future.

Activities

The first large-scale experiment in the Danube Delta was the opening of the dams at Babina, in April 1994. The dams surrounding Cernovca were opened in two places in the spring of 1996. It was important to use the old system of watercourses, i.e. to reconnect the water courses in the polder directly with the river water in the delta.

At Babina, four openings were constructed, to allow water to flow into the polder, at levels over 1m above the Black Sea water level. The goal was to promote uncontrolled flooding whilst using the existing channel network for the filling and emptying of the polder. The four openings were set in a way to enable the in and outflow of water in an optimal way; two in the Babina branch, one of which is close to the pumping station, and two in the Chilia branch. Two years later in early 1996 two further openings enabled the water to flow into the Cernovca polder.

Organisational and Legal Framework

Together with the Biosphere Reserve Authority, the Danube Delta Institute (Romania), the Dunaïskie Plawni Authority (Ukraine) and local NGOs, WWF aims to protect the natural values of the Delta and provide sustainable economic opportunities for local peoples. A central component of this effort has been the leadership of the WWF Floodplains Institute in carrying out the restoration of wetlands, which were unsuccessfully drained for agriculture. At the first international planning seminar in 1991, organized by the Danube Delta Biosphere Reserve Authority and IUCN, WWF, together with other international organisations agreed on a baseline for the future restoration. This emphasised the importance of the hydrological regime, and that all research and restoration measures should be regarded as closely interrelated. Although the hydrological regime was relatively easy to achieve, the actual rehabilitation was believed to be a long process.

In 1993, WWF agreed with the Danube Delta Research and Design Institute and the Danube Delta Biosphere Reserve Authority to start the first restoration in two agricultural polders as part of their Green Danube Programme. The WWF Floodplain Institute added its expertise, as consultants to the project, and also assisted with the monitoring.

Management

The management of the activities and the monitoring were the responsibility of the Danube Delta Research and Design Institute. A management plan, which will outline the future use of the area is in a planning stage and will be completed by the end of 1999. The plan will cover the issues of the sustainable use of all resources, such as reeds, fish and eco-tourism. It also explores the possible uses which are of an ecologically sound nature, for pastures under the new hydrological regime, which were originally planned for rice cultivation. The site management is now the responsibility of the Danube Delta Biosphere Reserve Authority.

WWF, and in particular, the WWF Floodplain Institute has been involved not only in giving expertise in the initial phase, but has also committed itself to accompany the project throughout the years, contributing to the monitoring and providing capacity building facilities.

Evaluation

Monitoring

The monitoring has been set up and carried out by the Danube Delta Research and Design Institute. This has been designed for five years, with support from the World Bank. The monitoring considers hydrology, soils, vegetation and fauna with regard to area specific biodiversity. WWF Germany contributed financially and sent its experts from the Floodplain Institute to assist in the monitoring. The WWF Floodplain Institute together with the Danube Delta Research and Design Institute set up a monitoring scheme to document the development that occurred after the reconnection of the polders to the Danube. Studies were carried out before and after the restoration, which includes a number of sample sites over both islands, with pitfall traps to survey the invertebrate fauna. Here mainly Carabid beetles, spiders and other beetles were sampled and compared. Additionally, at all sample sites sweep-netting and light traps have been used to survey butterflies, bugs and crickets. The vegetation was monitored before and after the restoration. Birds, fish, amphibians and reptiles have been monitored by the Danube Delta Research and Design Institute.

Experiences

The major experience, quoted by all people involved is the speed in which the aimed changes in the vegetation took place. The change of terrestrial vegetation into aquatic vegetation has been enormous and as there were no references from other sites, development of this aspect of the restoration was quite unexpected at this speed. Already, 60% of the islands are again covered by reed and similar aquatic vegetation. It is supposed that the seeds of many wetland plant communities survived the dyking in both the soil and in the water courses in the polder. The reconnection also will have improved the seed transport into the islands.

For Babina, five different hydrological situations could be observed, where, only one or two openings were used for inflow, while the others were for outflow. Some sedimentation has been noticed already. The flooding varies in its extent, but it is stable as a process, and hence, the flooding system has been successfully re-established.

An important component of the rehabilitation of the islands was the accumulation and turnover of the nutrients. Oxidation and reduction in the soil (redox reactions) imply a transformation of minerals into organic matter and vice versa (C, N, P, S). The nutrients and sediments contained in the water are filtered by vegetation, and also held within it, by bioaccumulative layers. In this way the water is

clarified, purified and submitted to a transformation process, according to the interrelations of biotic and abiotic factors. The faster the vegetation and habitats establish themselves, the better this system works. According to samples taken in the first years after the flooding: carbon, nitrate and phosphorus values had been falling. The results were due to the rapid development of reed beds and other aquatic plant communities in the polders, such as widespread *Nymphoides peltata* coverage and water lilies, including the rarer *Nymphaea candida* and *Potamogeton* societies.

A similar situation could be observed on Cernovca, where only two openings were enough to flood the former island, very quickly after the opening in May 1996. Reeds had already developed well in the first year, and signs of similar assemblages of aquatic plant communities as on Babina, have been registered.

Among the fauna, the spiders are of extraordinary importance for the entire Delta as well as for the two islands. A total of 217 species have been recorded in the region (the Chilia branch of the Danube), much more than at any other site along the Danube floodplain. In the restored and flooded polders 66 species of spider were recorded, consisting of 42% of the epigaeic fauna, the highest proportional dominance. Other groups like dragonflies, locusts and Carabid beetles rapidly re-inhabited the area. The speed of the resettlement depends on the development of relevant habitats and on the mobility of the species and its adaptability. The re-conquest of the invertebrate fauna in Cernovca island took place so rapidly, that although it was flooded two years later than Babina, no major differences in species composition could be observed, even in the mid-late part of 1996. In July 1996, 36 species had been recorded in pitfall traps in Babina, whereas 28 species had been recorded in Cernovca. These species can be used as indicators for the ecological quality of the area.

Two years after the redevelopment of the reed stands, the majority of the typical butterfly species, including the characteristic Large Copper *Lycaena dispar rutilans* reappeared. The investigation of the limnofauna and the zoobenthos give preliminary answers about the influence of flooding and its affect on the salination status. Inundation does have a positive effect on the desalinisation in the polders. The zoobenthos is dominated by phytophilous and limnophilous species. Rheophilous species are still absent but can be expected in the near future, as evidence of temporary running water has been found. The differential development of the zoobenthos between the two polders reflects the time needed for the species to resettle due to the different lengths of time since the polders were re-flooded. A potentially huge reservoir of zoobenthos as a major food source for fish is developing among the submersed vegetation.

The increase of fish species is the most impressive, developing from the presence of 2 species in Babina in autumn 1993, just before the opening, to 15 species in 1995. The opening in Babina in April 1994 coincided with the reproductive climax of the cyprinids, which visited the new polders in large schools and spawned immediately thereafter.

The avifauna in Babina also changed dramatically. The diversity increased from 34 to 72 species. The first breeding water birds were Coot *Fulica atra*. The flooded pastureland was visited by many birds, of which herons, terns, ducks and pelicans were the most numerous. With respect to species occurrence the White Pelican *Pelicanus dalmatinus* was the most common. In the reeds, herons dominated, consisting of 34% of the total number of birds present.

Constraints

During the planning, implementation and monitoring no major problems have been observed. In this respect it has been very valuable to put some effort into increasing the public awareness about the whole restoration project. This has been particularly acknowledged by the local people. It has been shown that this kind of awareness raising requires further development and that different sectors ranging from the local population up to the administrative level need to be targeted. Being at the end of a long river, the Danube Delta naturally faces a lot of problems, which derive from sites further upstream. Persistent pollution and events like the Balkan War do have a major impact on the Delta, but the more that the entire valley and the Delta is rehabilitated, the greater will be the natural buffer

against these effects. The benefit will then be clear for the Delta and its people, as well as for the Black Sea.

Ecological Benefits

The somewhat explosive growth of the reed mace population reflects high bioproductivity and has an important resource value, resulting from the function of carbon adsorption and retention. Thanks to the wetland's characteristic aquatic and swampland vegetation, the area may have already begun to function as a filter of sediments and nutrients. The former wetland species composition is about to re-establish itself, and quickly. Fish sampling, showed a recovery of the natural fish species composition. Samples in May 1996, already showed an optimal ratio between non-predacious and predacious fish, typically found in flooded areas.

Economic Benefits, Costs and Funding

No figures about the exact costs were available, but they seemed to be rather high. The costs involve the broad monitoring set up, in addition to the construction works and the accompanying work by staff from the Floodplain Institute, who annually travelled to the project sites. The Romanian government covered the majority of the costs, with considerable contributions from the GEF of the World Bank. The annual contributions of WWF-International via the Floodplain Institute were GEM 40,000. The economic benefits are striking. Already, after only four years, about 15 fishermen can make their living out of using the area of Babina. For Cernovca, it is too early to state any figures, but it is expected to be as equally viable as in the Babina polder. Hence, natural resources, namely reed and fish, have become available in economically profitable ways, despite only the short time since the restoration began. Thanks to the optimum conditions for Cyprinids after reconnecting to the flood regime, a higher abundance of young fish may be observed. This means that it is likely to stabilise the fish stocks, which will be to the benefit of the local people.

Social Benefits

The successful restoration of the wetland will provide many fishing families with an income. Additional prospects of sustainable grazing, reed cutting, sustainable hunting and eco-tourism will increase the economic basis and the acceptance among the local communities of the restoration, so the support is very high. The strength of the support can be seen, considering the fact that some fishermen had already tried, illegally, to open the dams before the restoration had started.

Conclusion

After only four years the rehabilitation has already proved to be a successful ecological and economical alternative to the management of the previously unprofitable polders in the Danube Delta. The rehabilitation potential is very high and the speed of regeneration is unexpectedly quick, and further such projects will only increase the benefits to the local population.

This project clearly has been one of the most successful of its kind in Europe and this fact has been well recognised, by receiving the WWF Conservation Merit Award in 1996, the Eurosite Award in 1995 and the AGIR Award in 1995.

But, there is often concern expressed, about the fact that the natural processes regenerate so quickly, after having been disturbed so heavily. "We are always quite happy that most of the time natural succession is quick (e.g. Kühkopf, Rastatter Rheinaue, Danube Delta), but it is also a danger to give that too much publicity, as it induces land-owners, decision-makers, and polluters to be confident that nature can be restored, which is not always the case." This view of some scientists might be a bit pessimistic and no longer valid, as it seems that now more and more governments and industries all over Europe are taking up river restoration in their agenda. An important issue raised by people involved in the restoration, is the need for further environmental education at all administrative levels, and capacity building in the form of training and workshops, to ensure a successful continuation of this approach.

Acknowledgements

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References

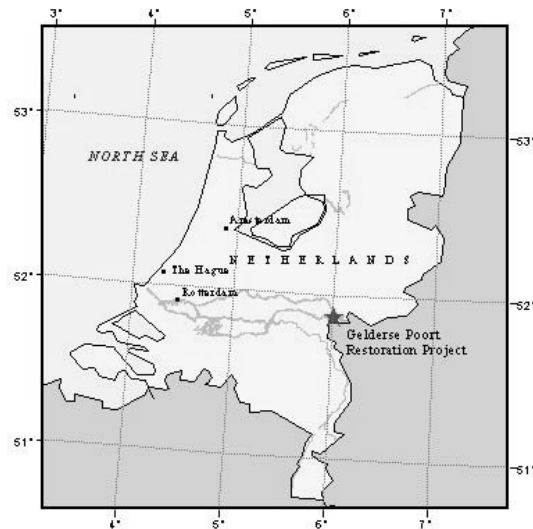
ICDD, WWF-Auen-Institute (1997): Ecological restoration in the Danube Delta Biosphere/Romania. 120pp.

2.2.5 Gelderse Poort Restoration Project

Description and Context

Location

SE The Netherlands, where The River Rhine crosses the border with Germany. 6°01'E, 51°52'N. See map (Figure 2.6).



Background

The Gelderse Poort is situated at the division of the lower Rhine and the River Waal, close to the German border. Here, the River Rhine passes through glacial sands between the towns of Nijmegen to the south and Arnhem to the north. The division of the Waal has always been a crucial strategic point. A fort was built here in 1742 and renewed in 1869. It had limited use during World War II, but its remains still exist as a witness to the very strategic nature of this place.

Traditionally, the floodplain has been used as farmland, but in recent decades the intensity of use has increased considerably. Another important aspect of the landscape is determined by the extraction of clay. The floodplain clay is an important economic asset for the area and for the whole of the Netherlands as it is used for the production of bricks for the construction industry. Often this manufacture was actually carried out in the area itself, as the remains of brick works and their chimneys in the landscape still illustrate. In fact, modern brick works are still present in the area.

In the so called "Ooievaar" plan of 1987, a few private people from different interest groups, first presented the idea of achieving a natural dynamic system in the river floodplain. This plan included the need for sustainable flood control measures and the long term security of local people's income. After approval by governmental bodies, representing the ministry of agriculture and fisheries, the ministry of the environment, and the ministry of traffic and water transport, the idea became an official plan, for a protection strategy for all floodplains in the Netherlands and beyond. The plan was initially conceived because of the observations that a few people made along the shore of the Waal. They noticed that the river in some selected areas still had the power to create sand dunes. More importantly they found that there were seedlings of the officially extinct Black Poplar *Populus nigra* growing on the shoreline. In fact, it was cattle that fed on the seedlings, which were preventing the natural development of the floodplain forest. Realising the potential for the natural afforestation, the idea was further developed with friends from all disciplines and a design for the development of a natural floodplain was formed. This plan became the basis for the Gelderse Poort Management Scheme, to increase the natural dynamics of the river, but also to include the need for flood control and satisfy the interests of local farmers.

The Millinger Waard (a 600ha floodplain) is one of 8 Dutch focus areas in the Gelderse Poort and will certainly function as a model for many other floodplain restoration projects in various regions of the Netherlands and Germany. Here, the first activities took place, and the first lessons were learned. The following report will focus on the Millinger Waard only.

Habitats

The main channel is canalised, designed for ship transport, and is stabilised on its embankments with stones and groynes. Islands also have been stabilised by stones. Where the embankments have been constructed, there are hardly any vegetated areas directly connected to the river. Prior to the construction of the embankments, the forelands (the zone between possible high and low water levels, between the canal and the embankments) were mainly used as grassland, but were increasingly farmed more intensively as arable land. The embankment, only locally, is covered by softwood forest, and only one remnant of hardwood forest (poplar, oak etc.) is left in the Millinger Waard area. Due to enormous flooding in recent years, some small sand dune remnants were re-activated or newly reformed locally along the river.

Biodiversity

Table 2.5: Key species in the Gelderse Poort area

Taxonomic Group	Species
Aquatic Flora	<i>Nymphoides peltata</i> .
Terrestrial Flora	321 spp. (48 Red listed) including: <i>Salvia pratensis</i> , <i>Primula verus</i> .
Invertebrates	Odonata: 21 spp., including: <i>Anax imperator</i> , <i>Orthetrum cancellatum</i> , <i>Cercion lindenii</i> . Lepidoptera: 175 spp., including: <i>Orthosia miniosa</i> (regional Red list). Orthoptera: 12 spp. Including: <i>Conocephalus dorsalis</i> , <i>Mecosthetus grossus</i> . Carabid Beetles: 58 spp. (7 Red listed). Molluscs: 33 spp. (7 Red listed).
Amphibians	High numbers of Natterjack Toad <i>Bufo calamita</i> .
Fish	Carp, Pike <i>Esox lucius</i> , Sunbleak <i>Leucaspius delineatus</i> .
Birds	192 spp. in total, among them many water birds. Breeding birds: 105 spp breeding (60% of the entire Dutch breeding birds), including: Garganey <i>Anas querquedula</i> , Corncrake <i>Crex crex</i> , Avocet <i>Recurvirostra avosetta</i> , Black-Tailed Godwit <i>Limosa limosa</i> , Common Sandpiper <i>Actitis hypoleucos</i> , Black Tern <i>Chlidonias niger</i> , Kingfisher <i>Alcedo atthis</i> , Nightingale <i>Luscinia megarhynchos</i> , Bluethroat <i>Luscinia svecica</i> , Stonechat <i>Saxicola torquata</i> , Penduline Tit <i>Remiz pendulinus</i> .
Mammals	European Beaver <i>Castor fiber</i> , introduced in 1993 from the River Elbe in Germany.

Land Use Prior to Restoration

The most intensive human uses occurred in the grassland and arable habitats, and also in the open river channel. Agriculture on the forelands was made possible by the existence of summer dykes. Clay extraction for the brick industry also took place on the forelands, as this is where the river had deposited many layers of silt. In addition, navigation was an extremely important role served by the main channel. This remains as one of the most important and busiest inland shipping routes in Europe.

Ownership

The greater part of the banks of the River Waal are under state ownership and therefore within the national domain. Prior to the restoration, substantial stretches were still privately owned and had to be purchased. Initially, WWF purchased a few key areas, but nowadays all ground transactions are carried out by the provincial government. With respect to the purchase of this land, the first transactions for the prospected polders are now complete, such as the Klompenwarrrd. In the Millinger Waard, purchase by WWF began in 1992. To date a few private owners are left, including one with 80 ha, who is refusing to sell due to concern about hunting restrictions.

Protection

The area is not under any kind of legal protection. It has been recognised as an Important Bird Area (IBA) and is being developed as a Flora and Fauna Habitat (FFH). WWF and SBB (State Forest Company) have held a partnership since 1993, who fully co-operate in the nature management of this area.

Threats

The main threats to the natural ecosystem include:

- Intensification of agricultural practise
 - more cattle per ha
 - conversion of grassland into arable land
- Eutrophication
- Flooding with polluted river water
- Sinking of the groundwater level
- Hunting

Restoration

Objectives (goals)

The central objective of the scheme is to increase the biodiversity of the area. This will focus on the restoration of key natural processes, rather than of any particular species. In particular, the reversion to natural riverbanks and floodplain areas will enable the entrapment of more organic material from the river, hence increasing the water quality downstream.

Interrelated with the conservation goals is the creation of a more natural hydrological system. It is expected that the changes made to the riverbanks and floodplains will promote greater regulation of the water levels. Peak flood levels should decline due to the greater groundwater capacity, reducing the need for expensive, long-term dyke maintenance. Minimum levels will also be maintained as a result of increased water retention.

Finally, it is envisaged that the more natural river system, with increased access to open water, will have far grater potential for recreational use that it has in its current agricultural state.

Approaches

The restoration of the Rhine is based on partnerships. The various different partners exist within the conservation community, as well as outside, in governmental bodies and particularly within local and regional industries. The planning of the restoration activities was carried out within the framework of the WWF Living Rivers programme, and economic partners were enlisted, which in this case were the local brick companies. The Millinger Waard was among the first sites to draw attention from the conservationists. In collaboration with the Staatsbosbeheer (State Forest Company), WWF

Netherlands started a new approach to nature conservation in the area. WWF began to collaborate with the clay industry, which was responsible for exploitation in many parts of the Rhine floodplain, but which also was an important creator of wetland areas and other nature. Excavating clay is the major process to transform the agricultural floodplain into a lower, marshy floodplain. This also influences the water storage capacity in a positive manner. In collaboration with the clay company, WWF and the Staatsbosbeheer were not only able to redesign the old floodplain structure, with a larger diversity in topography, by extracting the sediment covering old river branches, but at the same time gained a potential financial partner.

Jointly, they employ a project team to manage the removal of the intensive agriculture by land purchase, providing alternatives for the farmers outside the floodplain. Their role is also to promote natural large scale grazing, as a management technique in the newly developed nature landscape. Importantly, safety aspects needed to be considered in this pioneering project, in order to maintain the integrity of flood defences. Therefore, some elements of the conventional approach still needed to be maintained, because without the large-scale land purchase, the extensive planning would not have been able to be implemented satisfactorily.

Activities

For the large-scale deconstruction of dams and dikes in the floodplains and restoring the river back to its former natural state, huge areas of land needed to be purchased. The land purchase is still ongoing, carried out by governmental authorities.

There are four main management tools which will be employed to achieve this nature restoration. These are: i). the construction of side channels, ii). declaying, iii). the removal of summer dykes and iv). the extending of groynes in the main channel. These approaches are interrelated and will combine to produce the desired effects on the ecosystem.

i). Firstly, the construction of side channels will promote the development of natural riverine-type habitats, whilst preserving the navigability of the main channel for the important shipping industry. The inlets for these channels will need to be designed to preserve a steady flow of water in the main channel. Side channels will reduce the water levels in the main channel by only a small percentage, and it is not envisaged that this change will harm the nautical aspects.

ii). Declaying is the term adopted for the mechanical removal of the clay layer that has been deposited on the floodplain over the last two centuries. These works are intended to be sensitive to the underlying geomorphology of the forelands, thus exposing the ridges and channels of the river ecosystem which existed prior to the canalisation. Due to the impervious nature of the clay layer it has had a significant impact on the hydrology of the ecosystem. Its removal will have a large impact, increasing the groundwater capacity and level.

iii). Removing the summer dykes which exist between the main channel and the forelands, allows inundation of these areas, increasing the infiltration capacity of the whole river system. Although agricultural land is lost, valuable wildlife habitats are gained and there is a significant reduction in costs, as the dykes no longer require maintenance.

iv). The above changes will combine to reduce the water level in the main channel, adversely affecting the shipping industry. To compensate for this, it is intended to extend the groyne system in the main channel.

At the time of writing this report only the first steps have been implemented. Part of the land has been purchased. To prepare for the reconnection of the river to the floodplain, the clay industry is currently declaying the area, creating a variety of wetland habitats varying in size and height or depth, suitable for a variety of different species. In most cases, the farmers have retreated from the area and new land management practices have been established, e.g. by introducing Polish Konik horses and Galloway cattle. These primitive grazing animals live in low densities (1 per 3ha), year round, in natural social herds.

Organisational and Legal Framework

The legal authority giving permission to any kind of alteration to the river system, such as the projected restoration, is the national government of the Netherlands, represented by the province of Gelderland. From the beginning, local people, private owners and land users have been fully incorporated at every planning stage. The consultation took place in various commissions coordinated by the provincial government of Gelderland. The provincial authorities are responsible for legislation in the Gelderse Poort, but a close collaboration and co-ordination with neighbouring German authorities, projects and initiatives is now established. In a bilateral agreement, the regional governments have agreed to the exchange of information on the major steps along the restoration or about any kind of activities which might help improve each other's projects.

Management

The Staatsbosbeheer and WWF are equally responsible for the management of the nature area. WWF has a big stronghold in the Netherlands and it uses its good reputation for promoting any type of restoration project. WWF perceives itself more as a mediating institution, and gathers all groups to ensure every possible beneficial collaboration for the project is considered and set up. It is also WWF policy to keep the ecological aspects in the spotlight. The actual management at the site is done by Stichting Ark, under the authority of the Staatsbosbeheer. Stichting Ark is a non-governmental organisation which closely collaborates with WWF.

Evaluation

Monitoring

Ecological monitoring work is carried out by professional biologists, as well as by amateurs. Monitoring of vegetation and birds (breeding, migration and wintering) has been undertaken since 1994 on a yearly basis. Other studies include the investigation of mammals, amphibians, fish, butterflies, dragonflies, Carabid beetles, wasps and bees, macro-lepidoptera and spiders, amongst others. The development of the beaver population is also intensively monitored.

Experiences and Constraints

There were a lot of unexpected events and surprises, both in a positive and in a less positive way. According to the primary aims i.e. to increase the natural processes such as flooding, erosion, sedimentation, natural grazing and natural succession of the vegetation, key species will document the relative success of these changes. As the yearly vegetation survey (since 1994) has discovered, the changes are, as expected, enormous. 33 new plant species have been found in the Millinger Waard. Among them is *Filipendula ulmaria*, indicating increasingly wet conditions, the rare *Orobancha minor*, and some bushes such as *Prunus padus* and *Salix caprea*. Large areas of thistles *Cirsium arvense* have been converted into more bushy vegetation, with *Sambucus nigra* dominating, and in wetter areas *Calamagrostis* and *Epilobium hirsutum* plant societies have developed. Transitionary plant societies such as the *Bromo-Corispermum/Chenopodietum rubri* complex are present in the proximity closer to the river.

It was only after extreme floods in 1993 and 1994, that reluctantly, the local people began to accept the restoration. The local population increasingly consists of inhabitants other than farmers, and there has been increased pressure from these people on the farmers to make them tolerate and promote the restoration initiatives. Most of the local people now encourage any further restoration efforts, as they expect economic benefits which may result from the increasing value of the area, due to improved recreational facilities. This development already is showing its first results, in increasing the number of visitors to the area.

There had been great concern in the first years following the change in land use, with respect to the increasing growth of thistles. This caused widespread misunderstanding, especially among the remaining farmers and the local people. In fact, the thistle problem only occurred in the second and third years after the arable land was set aside, and after four years, the thistle monoculture had gone. Now, the yearly thistle population depends upon the amount of flooding that occurs. When a layer of clay sediment is deposited, more thistles subsequently grow, but people don't worry any more, as they understand the thistles are not such a big problem, as their presence is not constant.

Using the Konik horses and Galloway cattle on large areas has also increased the habitat structure, due to patchiness created by the grazing. Unfortunately, further results from any monitoring particular to this aspect of the restoration are currently not available. These results are highly desired, for sharing the experiences gained here with other areas that are planning similar large scale grazing experiments.

Despite this, it can already be noticed, that the vegetation will eventually substantially change into more bushy and forest types. This raises the question among the water authorities (who are responsible for the security of Europe's busiest waterway, which is a sensitive area to large scale flooding), of how much forest can be accepted in the floodplain? The vegetation does have a damming effect, which can be beneficial, but also problematic for the security of the dykes. Earlier, this question was not discussed, but a new generation of hydrologists is more open to discuss this question. It looks as though the authorities will pursue these issues, following experience gained by WWF in co-operation with its partners in the Gelderse Poort area.

One of the most unexpected aspects was the finding of Corncrakes *Crex crex*, calling and breeding in 1997 and the years since. Corncrakes generally are on the increase in many areas in Europe, but certainly the new structures in the vegetation, with much insect life, might have helped them to establish in the Millingerwaard. Stonechats *Saxicola torquata* have also colonised, which are new in the area.

Ecological Benefits

The introduction of the European Beaver *Castor fiber* in 1993/94 was successful, although in the first year there were problems. Their first winter flood was extreme and a cold winter also caused a lot of deaths. In addition, some individuals were killed in road accidents. However, in 1997 they started to reproduce and in 1998, 7 families with about 30 individuals had established themselves over the whole of the Gelderse Poort. Tracks of their activities can be seen everywhere in the polder.

Table 2.6: Trend in birds (1989 – 1994) for the entire Gelderse Poort

Current Status	Species	No. of Breeding Pairs in 1994
Increasing numbers:	Little Grebe <i>Tachybaptus ruficollis</i> (since 1991)	39
	Cormorant <i>Phalacrocorax carbo</i>	218
	Greylag Goose <i>Anser anser</i>	367
	Goldeneye <i>Bucephala clangula</i>	1
	Sparrowhawk <i>Accipiter nisus</i>	14
	Hobby <i>Falco subbuteo</i> (since 1991)	8
	Spotted Crake <i>Porzana porzana</i>	12
	Baillon's Crake <i>Porzana pusilla</i>	3
	Curlew <i>Numenius arquata</i>	9
	Mediterranean Gull <i>Larus melanocephalus</i>	1
	Kingfisher <i>Alcedo atthis</i>	5
	Lesser Spotted Woodpecker <i>Dendrocopus minor</i>	9
	Sand Martin <i>Riparia riparia</i> (since 1991)	497
	Bluethroat <i>Luscinia svecica</i>	64
	Serim <i>Serinus serinus</i>	2
	Scarlet Rosefinch <i>Carpodacus erythrinus</i>	1
Decreasing numbers:	Bittern <i>Botaurus stellaris</i>	Unknown
	Teal <i>Anas crecca</i>	6
	Shoveller <i>Anas clypeata</i>	103
	Redshank <i>Tringa totanus</i>	97
	Black-headed Gull <i>Larus ridibundus</i>	953
	Whinchat <i>Saxicola rubetra</i>	1
	Sedge Warbler <i>Acrocephalus schoenobaenus</i>	8
	Great Reed Warbler <i>Acrocephalus arundinaceus</i>	24

Flora: An increase of woodland species, species of the wetland succession, and some reeds.

The replacement of grassland by woodland will gradually add to cut off the peaks at high flood events.

The increased area of natural habitat has direct benefits for wildlife, and this also provides a greater potential for the biological filtering of the nutrient rich river water. This will improve water quality in the river itself, as well as reducing nitrogen and phosphate pollution in the North Sea, where the sediment currently settles out.

Economic Benefits and Costs

There is no information available about the costs of the project, and most of the activities still have to be undertaken. A reduction of long term maintenance costs of the dyke system will be a benefit, after their removal. The largest economic benefits are currently the income from the clay industry. This not only has direct financial benefits (because it partly pays back the price for purchasing the land), but increases links between the conservation community and industry. At present, one single flooding incident in the Millingerwaard in most places adds about 1cm of new clay sediment to the area (4 floodings in the last 6 years), but on the sandy river dunes, more than a depth of 1m of clay has built up in the last 10 years. This overall pattern of deposition means that the economic benefits will be a continual asset.

Due to the increasing potential for recreation in the area might, the tourism industry is already becoming more valuable. Figures on this subject are also not yet available.

Social Benefits

The increasing potential as a resort for recreation, will improve the standard of living of the local people as well as for the wider public. Only some land users are still sceptical about the restoration. Scientific achievements and NGOs have responded very positively so far. This will enable the project to progress and develop as a model for the entire region, for the many already planned projects, and possibly further beyond into adjacent areas along the River Rhine in Germany.

Conclusion

The close collaboration of WWF with governmental and non-governmental bodies, and with industries as well, seems to be an ideal partnership in successfully progressing in the matter of river restoration. This seems to be a successful model not only in the Gelderse Poort, but also for other projects in the Netherlands, and could possibly be used by many other countries and WWF national organisations.

These partners have again chosen new partners in industry. This is an entirely new approach and seems to work very well, as the interests of both conservation and industry more or less go hand in hand, as in the example of the Gelderse Poort project. The Ooievaar Plan gives the general background. This plan has enabled understanding, both internally for those directly involved, but also for the general public, and provides a widely accepted platform for a nation-wide river restoration. Almost all ministries and a great number of industries and stakeholders agree with the plan, and this unilateral support is the basis for future restoration work. In this process, WWF works as a catalyst, understanding its role in promoting the project, to raise public awareness and to fund the initial steps in the restoration of rivers.

River systems in the Netherlands have been strongly shaped and altered by man. Large rivers like the Rhine, the Waal and the Meuse have their deposition zone in the Netherlands, with larger problems in the upper river zones. An enormous list of threats, require the need of political acceptance and high cost involvement, to address these problems. Only through the alliance of NGOs, government and industry can this be ensured.

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References

Helmer, W., G. Litjens & W. Overmars (1993): De Gelderse Poort. Landschap 10/3: 69-83.

Living Rivers (1993). World Wide Fund for Nature. 28pp.

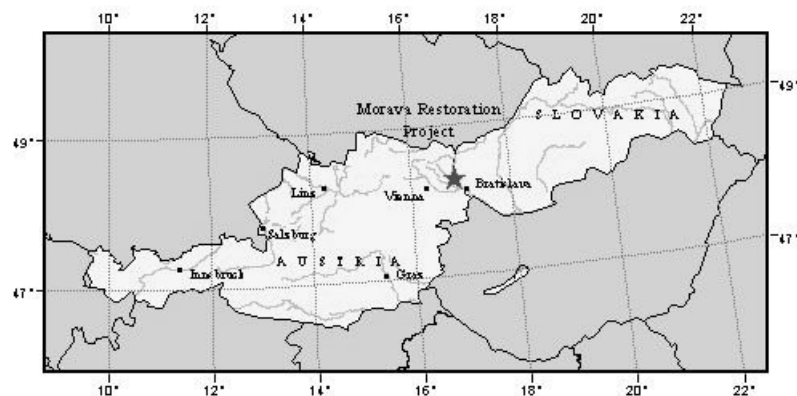
Vegetatieontwikkeling in de Millingerwaard 1994 -1998.

2.2.6 Morava Restoration Projects

Description and Context

Location

Floodplain of the River March (Morava) at the border between Austria and Slovakia at 16°54'E, 48°17'N. See map (Figure 2.7).



Background

The Morava (Marchauen) is a middle sized lowland river on the western most boundary of the Panonian steppe, with cold winters, hot summers and low precipitation. The river is a tributary of the Central Danube, which incorporates the border between Austria and Slovakia in the project area. On a yearly basis in late winter, early spring, the river regularly floods into the very broad 5km floodplain. The flooding is long lasting and rises gradually, contrary to that seen in other rivers which are set in a much narrower valley and/or are restricted either naturally or artificially by dams.

In the 1950s and 60s, the major activities that took place along the river focussed upon its regulation. Several meanders were cut short and eventually the river course was considerably shortened by 11 km. Summer dykes and traverses prevented the river channels in the area from being connected to the natural dynamics of a naturally flooding river ecosystem, resulting in the gradual sedimentation and lack of natural erosion in all adjacent water courses. The regulation work was completed in 1967, but the need for maintenance of these measures has continued up until the present.

As early as 1970, WWF had already purchased the majority of the floodplain forest in Austria between Zwerndorf and Marchegg to the South. The area became famous well beyond the region due to the tree-nesting White Storks *Ciconia ciconia* near the Marchegg settlements. Formerly, this area was also used as grassland for a variety of uses, but increasingly the floodplain became planted and gradually grew over into a forest.

The Slovakian part was inaccessible for a long time, but after 1990 with the fall of the Iron Curtain, a dramatic improvement in accessibility started. Already in 1996, the first restoration had begun on the Slovakian side of the river.

The Morava river is the most important meandering lowland river of its kind. The river restoration in the project area is only the first step of a larger restoration plan to reopen the entire Thaya-Morava floodplain and try to reconnect the old river channels into the main river course along a stretch of almost 70km.

In the following report, the major focus will be on the WWF owned floodplain on the Austrian side of the Morava river, but information on the recent activities on the Slovakian side, will be included, where applicable.

Habitats

The project area covers about 1,160ha on the Austrian side (approx. 3,000ha in total), and consists mainly of hardwood and softwood floodplain forest (860ha) with scattered ox bow lakes, old river channels (e.g. the so called Maritz) and a very small number of grassland habitats (160ha) along the edge of the park. About 10% of the forest has been designated as core area, not permitting any use and promoting natural succession, but the total area taken out of any economic uses is most probably even larger. The rest of the forest is being used in a sustainable way. WWF tries to demonstrate forest practices, which harmoniously conform to the conservation objectives.

Biodiversity

Mammals

Among the mammals, the European Beaver *Castor fiber* is not only the most spectacular but also most important riverine species. Otter *Lutra lutra* also occur, but are still rare.

Birds

Most striking among the rich bird fauna is the tree-nesting colony of White Storks *Ciconia ciconia* with up to 60 pairs. There are also 220 pairs of Grey Heron *Ardea cinerea* and a few pairs of Black Stork *Ciconia nigra* which also occur in the forest. Recently, the White-tailed Eagle *Haliaeetus albicilla* settled in the area. A first breeding attempt was observed in 1999. Other birds of prey include the rare Saker Falcon *Falco saker*, which breeds almost annually. Five species of woodpecker have been found breeding and many other forest species occur in the floodplain forest. The meadows have been increasingly visited by Corncrakes *Crex crex*. A complete list of the bird species was not available.

Amphibians

The area is rich and famous for its frogs and toads. The visitor can encounter more than 6 species, all calling in spring with the Fire-bellied Toads *Bombina bombina* dominating with their characteristic humming sound, accompanied by the noisy Tree Frogs *Hyla arborea*. Other species include Green Toad *Bufo viridis* and Marsh Frogs *Rana ridibunda*.

Fish

The fish community of the Morava-Dyje system is extremely rich, with over 50 species known to be present. The main fish species include the Wild Carp *Cyprinus carpio*, Zander *Stizostedion lucioperca*, Pike *Esox esox*, Sterlet *Acipenser ruthenus* and the rare Eastern Perch *Stizostedion marinum* amongst others.

Invertebrates

There are no lists available of inventories carried out to survey the invertebrate fauna. Among the rich invertebrate fauna, it is worth mentioning the striking Southern Festoon *Zerynthia polyxena*, which has a stronghold in the meadows along the forest margins.

Land Use

WWF shares the area with another landowner, whose major interests are in the economic values of the area. Forestry, and particularly hunting as a major income, has to be maintained. The hunting, subsequently has a lot of implications on the forestry practices. A number of attempts to replant natives trees in many parts of the area have been counteracted by grazing pressure from too many deer, particularly Red Deer *Cervus elaphus* at a stocking density of 12 per 100ha. This is quite high and prevents the re-growth of trees. The majority of the forest is still in use but WWF is trying to apply new methods of sustainable forestry. This has meant that the forestry practices have been reduced in recent years, with areas determined for natural development, in accordance with a management plan, which was elaborated by the Floodplain Institute in 1987. The timber use from the forest has changed from the so called "Mittelwald" (middle sized forest) to "Hochwald" (pole), which means that the trees are not felled early for fire wood, but left growing into a forest, which is both

diverse in species and age groups. Timbers cut from this kind of forest are mainly restricted to older trees, used for furniture and building purposes. Only half of the annual growth of 3,000 cubic meters of timber is removed each year. In this way the forest is less disturbed and more diverse. The main tree is a special eastern ash species, the Narrow-leaved Ash *Fraxinus angustifolia*. Others play a minor role. It is in the interests of WWF to encourage ash trees to grow from seedlings, to promote the means for sustainable forestry.

The major land use remains the forestry in the existing nature reserve, but in accordance with the recommendations of WWF, in a less intensive way. There are core zones with no permitted timber use and 160 ha are used as meadows, with differing management schemes. It was important that the meadows were kept open for Corncrakes *Crex crex*, White Stork *Ciconia ciconia* and various flowers such as the Aufrechte Waldrebe *Clematis angustifolia* and the Autumn Crocus *Colchium autumnale*.

Hunting and fishing are still permitted land use practices. With the hunting only partially restricted in the floodplain area, this is a concern for the project area. The hunting of waterfowl is not permitted, but deer hunting is carried out, although not strictly in alliance with the needs of nature conservation. Fishing is quite considerably restricted. Only 20 of 50 possible fishing permits have been granted, in an area which is easily capable of holding three times the number. These are distributed from the regional fishing board, responsible for all Austrian fishing permits. Certain areas in the project areas, along the interior watercourses and along the river in the forest are generally declared as no fishing zones.

The area is also an important resort for recreation and increasing numbers of visitors explore the area every year. In 1998 this number almost reached 50,000 visitors. This pressure did not lead to any problems, as most of these visitors are well aware of environmental issues of concern in this area. In addition, a system of guiding paths, with watch towers and hides has improved the situation, and prevents unwanted disturbance.

Threats

As has been described in the background information, the floodplain has been heavily altered by the regulation of the river. Other more current threats include:

Austria

The area has been recognized as a wetland of international importance and has accordingly been designated by Austria as one of the first Ramsar sites. But due to its hydrological deterioration the site has been listed on the so-called Montreaux list, covering sites which have since deteriorated.

Slovakia

The Slovakian site has been under serious threat by the gravel industry, which plans to extract gravel from an area of almost 800ha. Also, after the political changes in 1990, which increased the number of visitors to the border area, this meant that these people could reach formerly remote areas. As a consequence, a colony of Spoonbills *Platalea leucorodia* has been devastated due to an increase in fishing near to the colony.

Ownership

Austria

About half of the project area belongs to WWF, who had bought the area already by 1970. The other 50% was bought by the local community, but, as it turned out, it was unable to hold the property, and was forced to sell to a private owner. With this owner, WWF has had to agree on the land uses and duties which are carried out on the property. As the private owner's major interest is in maintaining hunting, an agreement on the management of the site is not always easy.

Slovakia

The Slovakian side is in the property of the local communities.

Protection

As early as 1973 the area was partially designated as a nature reserve, but in 1978 the whole area was eventually designated, under the responsibility of the regional government. In December 1982, the Austrian part was designated as a Ramsar site. The Slovakian site's designation followed in 1990, so that the entire floodplain in both countries is listed under the Ramsar convention, which gives the site special attention. But, in 1990 the Austrian site was added to the Montreaux list, which lists designated sites that have obviously been neglected and seem to have deteriorated in their condition of conservation value. This problem has partly been attributed to the poor hydrological situation in the floodplain and in the Morava itself.

There are plans to designate the Austrian side as a national park

Restoration

Objectives (goals)

Major goals include:

- The improvement of the river hydrology by decreasing erosion in the river channels in the floodplain and preventing further sedimentation in those river courses.
- It is also intended to improve the water quality and further soften the flooding impact.
- To preserve areas with valuable biodiversity and to enhance and stimulate new characteristic species

All land use activities should be guided by these overriding goals, and be approved in a sustainable way. Firstly, forestry should be carried out in a way which could demonstrate the co-existence of timber production and mutual benefits for biodiversity. Hunting and fishing should also only be allowed in a restricted way, to prevent disturbance and overexploitation.

Approaches/Activities

Slovakia

Already in 1996 with funding support from the World Bank, the Slovakian authorities reconnected three old river arms back to the main river course of the Morava river. Those were the 3rd, 5th and 7th river arms.

Austria

Early activities involved WWF in the essential land purchase. This was an essential and important step before any restoration could take place. The purchase of the majority of the land had already been completed during the 1970s and legal protection of the site has been promoted. Any restoration must be based on this legal framework.

WWF also funded a study which investigated the best ways of implementing any activities on the water courses which would improve the hydraulics. From this study, eight sites were chosen, where in 1998 the traverses were lowered along 20m stretches, to improve the internal water flow between the channels and enable the water to be retained in the floodplain for a longer period. This has been done in preparation for the main reconnection of two major river arms (the 4th and 6th), which is planned for the year 2000.

The very last stage is planned to actually retreat the current dyke to a position further back inland, in order to increase the retention area and also to actually shorten the remaining dyke line. All activities should serve as a model for the entire Morava-Thaya region and deliver enough experiences to accelerate the process of other river restorations. A project proposal for EU funds under the LIFE scheme has been prepared in order to cover the main costs of this huge exercise.

A smaller land proportion will be used agriculturally, which will be an economically important aspect of the floodplain. To encourage farmers to practice sound ways of farming, 8.5 million GEM have been made available to compensate the conversion from cropland into meadows. The money is also available to encourage farmers to set aside land for forests, to allow wetter conditions on their ground and use their forest parts less intensive. More than 150 farmers have gained from these funds.

Organisation and Implementation

Austria

WWF and its co-owner employ a forester, who is responsible for the land use, including the management of the meadows. The forester is also acting as a warden, for all the various tasks applying to the site. The Morava reserve is particularly diverse, due to the variety of its habitats and different management schemes inside the forest, the meadows and within the watercourses.

The project area is a nature reserve, and hence is supervised by the regional authority for nature conservation for the Land Niederösterreich. This authority is responsible for any legal framework and action, binding users and stakeholders in the area, and can also be involved during the planning and implementation stages of the restoration projects, including this river restoration.

The latter is fully under the responsibility of the water way administration (Wasserstraßendirektion WSD), which is the authority responsible for river management in the region, including the Morava, which still operates as a water way, even though no navigation is currently taking place. Additionally, any planning must involve the Border Commission, which looks after each country's interest in terms of river use and other implications deriving from any activity along the river.

Slovakia

The projects on the Slovakian side were carried out by the regional NGOs, but have often been initiated, promoted and managed in close collaboration with WWF, with financial support from the World Bank.

Management

WWF employs a manager of the area, who is responsible for the entire area, including the part owned by the second landowner. The main management comprises the forestry, the water management and the land use of the meadows. As the area is legally protected, any kind of change has to be accepted by the "Bezirkshauptmannschaft", a local authority situated in Gänserndorf, and the nature conservation authority in St. Pölten.

Evaluation

Monitoring

Slovakia

The University of Bratislava has been carrying out a survey of the morphology, sedimentation and hydrology of the river after its restoration. In terms of changes in biodiversity, only fish have been sampled. Birds and the vegetation have been surveyed by DAPHNE, a Slovakian NGO involved in the conservation in the region. The surveys focussed on the meadows prevailing in the Slovakian site.

Austria

In connection with the implemented and future planned activities, WWF investigated the fish fauna. The WSD carried out a monitoring assessment of the hydrology and river morphology to monitor, in particular, the delicate sediment situation at the project site. Apart from large birds, such as herons, storks and birds of prey, no other monitoring has been carried out.

Experiences

Slovakia

The 1996 activities to reconnect three channels (old river arms), partly failed because a barrage to encourage the water to flow into these channels had not been included in the restoration. Also the entrances were only opened up by two thirds in the hope that the floods would then fully open them up, which was not the case. It was observed that after a short while, the entrances to the old river arms silted up, and the main discharge began to run through the more recent river channels once again.

Austria

From the first measures taken along the river on the Slovakian side, WWF and the WSD had already gained plenty of experiences through observations, which will improve the next steps of the restoration program in Austria. The measures taken here are still too recent to observe the results and gain further experiences.

Constraints

Danube-Elbe-Oder Canal: A major constraint for any future restoration planning is linked with the constraints associated with the inclusion of the border of two different countries and their differing visions of the future of the river.

The Slovakian side still believes the river might be of some significance for navigation, a thought not too unrealistic, considering its central position in Europe and the possible link between the Elbe, Oder and Danube. But, this option is putting considerable constraints upon any further planning of any restoration involving the hydrology of the river. It also has implications on the way the river channels may be reconnected and on the approaches to future river maintenance. About 10% of the prospected LIFE funds can be spent on the Slovakian side, which might help to buffer the constraints.

The second owner: WWF has to adjust all its plans and ideas for restoration, with the second owner, whose major interest is in the economic values of the land. This is not normally a big problem and satisfactory compromises can be made, but the interest of the second owner to use the area as a hunting resort, has lead to major conflicts with the interests of WWF, who wish to encourage a species composition belonging to a natural forest. The unnaturally high number of deer interferes with the interest of WWF to establish natural regrowth of forest stands. To try to address this problem, fences were constructed to prevent the deer damaging the young trees, but this can only be a preliminary solution, as the fences are highly vulnerable to flooding, which is planned to increase after the restoration is completed. The summer flooding in 1997 demonstrated these possible adverse effects and the fence was destroyed, and its function became worthless. Since this event, the planted ash trees have been affected particularly badly.

Partly, the management schemes for various species and other restoration objectives, differ and contradict with the different management demands of the various species. It is not always clear enough, which objectives have priorities in the long term. The management plan preserving the habitat of an irregular breeding bird such as the Corncrake *Crex crex*, with a late but regular mowing scheme should be flexible, and adapted to any new and changing conditions under a flooding regime following the restoration. In this respect, the recent construction of a dam by a beaver in 1999, at exactly the same site where the restoration activities had removed the artificial dams, demonstrates that once the dynamics are altered and more natural events proceed (such as the one described), they do not always occur according to any plan.

Ecological Costs and Benefits

Results from any of the surveys about the biodiversity are not available yet. The first breeding attempt by the White-tailed Eagle and the reestablishment of the Corncrake are promising, but not necessarily linked with the restoration. White-tailed Eagles are increasing throughout their range. Corncrakes are also on the increase over their range, but this species was certainly favored to settle in the Morava because of the now more favorable conditions.

The restoration activities are too recent and the monitoring results are not yet finished to be able to assess some of the ecological benefits of the internal measures. The major benefits will be expected to arise from the reconnection of the major arms, and there are plans to monitor the extent of their success.

Economic and Social Benefits

About 150 farmers in the entire Morava-Thaya Floodplain, including the project area, gained from generous compensation for converting intensive cropland into meadows and farmland with more environmentally sound practices. The local population is benefiting from this, economically and socially, by living in a healthier environment. This is often not recognised or acknowledged. For a long time the local population was very sceptical towards the conservation issues. Partly, this was due to insufficient information (public awareness) and no clear vision for the project area and the further region.

With a lot of public promotion and particularly with the "Storchenfest", an annual event to celebrate the arrival and breeding success of the White Storks in the village, WWF was able to raise awareness. This also enabled WWF to involve the people more in the project and made them identify with its objectives. In the 1980s, there was hardly any support from the community, but now the mayor of Marchegg is fully supporting WWF, and the municipality serves as an additional catalyst for the restoration project. This success is partly due to the increase of the White Storks, to the overall benefit of the community. In 1997 and 1998 the number of visitors exceeded 50,000, which has caused no problems for the reserve and its biodiversity, due to an elaborate system of channeling the visitors by the use of hides, information plates, a good system of paths and watch towers. The Morava reserve in this respect, truly serves as a good model for the social benefits of local people and using river floodplains for tourism in a sustainable way.

Conclusion

The Morava is a neat restoration project, in demonstrating how to progress by collaborating and including the local community. Exchanging experiences on technical and scientific aspects from the activities occurring on either side of the river in Austria and Slovakia has been important, and the time is now more favorable for further large scale river restoration projects to take place in the area. The economic values are as obvious as the ecological ones. The implementation of the hydrological restoration aspects only began in 1998, which is also when the monitoring began. Therefore, it still has to be demonstrated that the restoration will be successful, and to what extent.

Acknowledgments

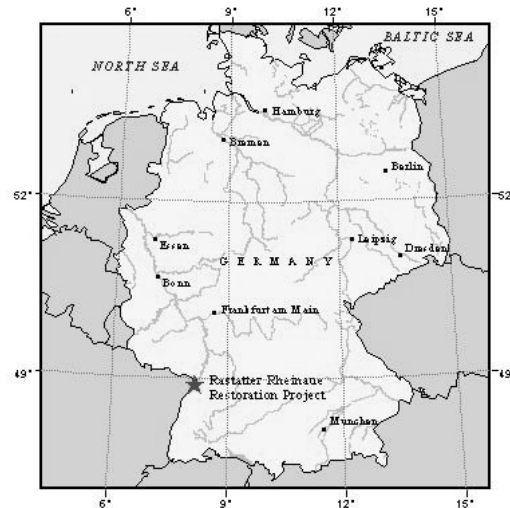
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2.2.7 Rastatter Rheinaue Restoration Project

Description and Context

Location

Upper Rhine section, on the right hand side, south-west of Karlsruhe, in the west of Germany, close to the French border. 8°10'E, 48°53'N. See map (Figure 2.8).



Background

Situated in the middle of the Upper Rhine Valley, north of the town of Rastatt is the approximately 900 ha project area “Rastatter Rheinaue”. Due to its special location at this point, the River Rhine contains elements of a furcation zone, along with elements of the old meander zone which are still present as relicts, in the form of dead river arms and oxbow lakes.

Until the Tulla Rhine Regulation around 1842, the river ran naturally in winding meanders with countless river arms and oxbow lakes. The regulation of the river and a series of 10 dams thoroughly changed the character of the floodplain. Under human control, the water runs from one reservoir into the next. The main dikes have been built close to the river embankment, limiting the floodplain to only a few very small areas.

This was still the principle situation in 1984. The Rastatter Rheinaue was one of the few remaining floodplain areas that flooded regularly, but was already tamed by dikes and dams.

In 1985, the WWF-Aueninstitut (floodplain institute) planned one of its first initiatives in the area. A year after the Rastatter Rheinaue had become a nature reserve (NSG) in 1985, WWF became the major consulting organisation. It accompanied the protection by also taking important measures in forestry and hydrology, in collaboration with the municipality of the town of Rastatt. The restoration mainly focuses on the nature reserve, but WWF also undertook some activities in the adjacent floodplain, which will be referred to in the text.

Habitats

Mainly hardwood and softwood floodplain forest with scattered ox-bow lakes, and a very small number of grassland habitats along the edge of the nature reserve. See Figure 2.8.

Biodiversity

Surveys on biodiversity only exist for forest trees, aquatic plants, herbs, isopods and diplopods, Carabid beetles and ticks. Birds were investigated in 1985 only. About 90 bird species, about 15 dragon- and damselflies and 379 butterfly and moth species have been recorded in the nature reserve. Information on other vertebrate taxa is sporadic and incomplete.

Table 2.7: Selected key species in the Rastatter Rheinaue

Taxonomic Group	Selected Species
Aquatic Flora	<i>Nymphoides peltata</i> , <i>Potamogeton densus</i> , <i>Ranunculus circinatus</i> , <i>Tolypela prolifera</i> .
Terrestrial Flora	The floodplain forest mainly consists of oak, ash, two elm species and the rare Black Poplar <i>Populus niger</i> . Other tree species can also still be found in the region, together with a large variety of terrestrial plants.
Invertebrates	<p>Odonata: no survey. Survey in the adjacent floodplain in 1992 found 38 species, indicating the potential of the area for these taxa.</p> <p>Lepidoptera: 379 spp. (44 regionally Red Listed with 5 on cat. 2 regional Red List): <i>Maculinea teleius</i>, <i>M. nausithous</i>, <i>Issoria lathonia</i>, <i>Chilodes maritimus</i>, <i>Chloroclystis chloerata</i>.</p> <p>Orthoptera: <i>Meconema merodinalis</i>.</p> <p>Carabid Beetles: 127species (preliminary list unpublished by Schneider mdl.): <i>Platynus longiventris</i>.</p> <p>Molluscs: 36 spp. 6 water snails and one bivalve are nationally Red Listed: <i>Unio</i> spp. strong decrease due to increasing waste water discharge and sedimentation, due to the lack of streaming of the main water.</p>
Fish	Carp, Zander <i>Stizostedion lucioperca</i> , Pike, <i>Esox lucinus</i> , Salmon <i>Salmo salar</i> (reintroduced), Sea Trout <i>Salmo trutta</i> , Spined Loach <i>Cobitis taenia</i> .
Amphibia	8 species, two regionally Red Listed: Yellow-bellied Toad <i>Bombina variegata</i> , Agile Frog <i>Rana dalmatina</i> , Green Toad <i>Bufo viridis</i> .
Reptiles	3 species: European Pond Terrapin <i>Emys orbicularis</i> , Grass Snake <i>Natrix natrix</i> and Sand Lizard <i>Lacerta agilis</i> .
Birds	There is no complete survey available. Breeding birds were studied back in 1985. The studies imply only quantities and differences in various floodplain forest habitats: 50 breeding species: Middle Spotted Woodpecker <i>Dendrocopus medius</i> , Turtle Dove <i>Streptopelia turtur</i> , Goshawk <i>Accipiter gentilis</i> , Black Kite <i>Milvus nigrans</i> , Hobby <i>Falco subbuteo</i> , Treecreeper <i>Certhia brachydactyla</i> , Hawfinch <i>Coccothraustes coccothraustes</i> . Five species of woodpeckers have been found in the oak-elm forest.
Mammals	No surveys undertaken, but Pine Marten <i>Martes martes</i> , Polecat <i>Mustela putorius</i> and Badger <i>Meles meles</i> are present.

Land Use

The major land use in the existing nature reserve is still forestry. The traditional uses included the felling of viable trees for building and furniture construction. Poplars have been used to make wood chips, exported mainly to the Netherlands, which are then processed and return in the form of fruit boxes. Willows that are dominant in the more shallow areas have been used traditionally for fascias and tool making. They were cut back every 5-8 years, but in accordance with the recommendations of WWF, this is now carried out in a less intensive way. There are core zones in the forest, covering about 20% of the area, from which no timber can be removed.

Hunting and fishing are additional land use forms, which still occur in the floodplain area. Hunting does not play an important role, whereas fishing is practiced intensively by two commercial fishermen and through sport fishing activities.

The area also is an important resort for recreation, particularly as the area is close to the transfrontier Thine Park, with European bicycle trails. Increasing numbers of visitors explore the area.

There are only a few houses scattered over the area, mainly in the northern part.

Current Ownership

The majority of the forest is public property. Almost all of the forest belongs to the local municipality, but a small part in the northern section (Murgwinkel) is actually owned by the French community of Münchhausen, because this part of land was previously to the left of The River Rhine. After the regulation of the Rhine, this part of land changed to the right side of the river, and so was within the German territory (because the border between France and Germany always followed the main Rhine channel, which changed after the regulation). After the Second World War, all the parts that were previously German, but now to the left of the river became French, but those on the right remained part of French municipalities. WWF did not intend to purchase any land in the area.

Protection

845 ha (of the approximate 900ha) of the Rastatter Rheinaue project area has been designated as a protected area (NSG, IUCN category II). This is because not all the area is a natural floodplain. There is still a small part of arable land in the south. Also, at the time of designation, the majority of the forest in the reserve had been plantations of hybrid poplars. Forestry is now restricted to five separate core areas, whilst natural succession and growth of natural trees is promoted by plantations.

Threats

One quarter of the reserve and the project area remains under the concession of extracting companies, but one of these concessions was purchased and stopped, in order to promote the conservation purposes. This extraction is a serious problem for many sites in Germany and not only on floodplains. The right to extract timber is of higher value than the legal protection of a nature reserve!

Restoration

Objectives (goals)

The main goals were the protection of semi-natural floodplain forest communities with their typical species composition. The goals include:

- Natural floodplain forest development;
- Sustainable forest use;
- Traditional land use forms;
- Disperse the peaks of high flood events over a wider area;
- Improve the hydrological situation in the floodplain;
- Enable the Rhine's water to run into the floodplain.

Approaches

In this restoration project, WWF collaborates with the town of Rastatt as a partner in the research project, which slowly implements the restoration measures. As the town of Rastatt is the landowner, it is a partnership with constraints, and any further steps in the restoration require the acceptance of the municipality. The traditional approach of buying land and implementing the restoration on their own

ground is not applicable, and it seems to have advantages to actually progress in consensus with the municipality.

For the opening of the floodplain to the river, it appeared necessary and useful to work hand in hand with the water authorities, who recently became more accepting of the modern restoration ideas. Once the water authorities were convinced, they were likely to have a positive influence on the municipality within this project.

Activities

WWF, in agreement with the owner, the council of Rastatt, initiated and promoted plans to slowly change the tree species composition of the floodplain forest. Oak, ash and elm trees were planted, to substitute hybrid poplars after they had been removed for economic purposes. This activity was agreed on, as part of a research programme promoted by the federal government of Germany. The gradual substitution of hybrid poplars with natural forest trees is a slow process. On the recommendation of WWF, the council agreed to set aside two core areas of about 10ha each, without any kind of forestry use. It has been agreed to gradually develop 70 % of the forest under a natural succession.

A second initiative of WWF in 1996, was to construct five fords on the higher situated paths in the forest, to promote a better access for the water to reach the river arms (Schluten) of the old River Rhine within the forest. It is the intention to increase the time of flooding, up to 80-120 days per year.

This was expected to have a positive influence on biodiversity, the growth of natural forest plants, as well as to improve the water quality of the river and its side channels. The central channel of the old River Rhine was only connected to the newer main river channel by a narrow gap of 1.5m. This has been widened to 3.5m, and additionally provided with a fish-passing device. To control the water input at this point, the inlet has been regulated by a weir.

There are long term plans to reconnect and reactivate the old Gäns Rhein by lowering the paths or by bridging it. This has been partly achieved, but two more activities need to be undertaken to complete the passage for water from the River Rhine to the River Murg.

Last, but not least, WWF was able to purchase the right to extract gravel from the area just outside the project area for 11 million GEM, raised during a television campaign. Following the purchase, WWF was then also able to construct a dam between an artificially dredged lake and an arm of the River Rhine. This was necessary to prevent the cooler, deeper lake water, from disturbing sensitive and fragile aquatic vegetation.

There have been further hydrological measures along the old river arms, which are now in the process of slowly revegetating. Mechanical clearance and dredging techniques have been employed to once again enable the river water to flow more often and faster through the river arms.

Organisational and Legal Framework and Management

The responsible authority for nature conservation is the municipality. Hence, being the landowner and the authority responsible for the nature conservation, the municipality is obliged to develop a management plan, together with the county. Unfortunately, this has not yet been achieved. The municipality is also responsible for renting out hunting rights, and they have not put any restrictions on this yet. Another responsibility is to control the number of fishing licenses, which gradually have been restricted.

WWF has been involved in a joint research project with its Floodplain Research Institute. With federal funding from the Ministry of the Environment and supported by the Land Baden-Württemberg, WWF and Rastatt town have developed a research scheme, which is designed to gradually exchange the hybrid poplars with natural deciduous trees, and to also monitor the change.

Evaluation

Monitoring

Apart from one initial survey on vegetation and arthropods, and an early study on the breeding bird community there has been very little monitoring. The only consistent monitoring taking place is the survey of tree development.

Increasing species: Increasing tree species were oak, elm and ash. To the great satisfaction of the conservationists, wild apple and wild pear reappeared in the core areas without any planting. Also particularly encouraging, is the growth of the planted elm specimens, many of which were taken from the Kühkopf area, 160 km further north along The River Rhine. Trees at this site are apparently more resistant to Dutch Elm Disease, which has eliminated so many elm trees all over Europe since the early 70s. Trees which have reached the age of 80 years or more in the Kühkopf area are doing well. Unfortunately, it is not known if there is a correlation between the trees growing in floodplain habitats and their apparent resistance to the disease, but those planted in the Rastatter Rheinaue are also doing well. It has yet to be seen whether this will remain the case.

Another surprise was that the planted oak trees are doing rather well, despite current scientific knowledge that suggests that oaks cannot withstand a certain amount of flooding days per year, and that they have difficulties in shaded situations.

There has been no specific survey of the fish fauna, but local fishermen confirm to having encountered new species every year, which is in alliance with an increasing improvement of the water quality, now almost reaching 2 on the German scale between 1 to 5 (1 meaning high water quality). In 1999, Sea Trout *Salmo trutta* and *Triops spp.* have been found as species new to the project area.

Experiences

- **Forest**

Two major experiences resulted from the research on the tree growth. Firstly, oak trees grew well on areas that were flooded for a long time, despite earlier research describing oaks to be trees that are limited by sustained long flooding events in the floodplain. Pine trees also tolerate flooding longer than expected. On elevated areas of gravel, pine trees can sustain flooding for about 5 to 10 days. Elm tree saplings taken from the Kühkopf floodplain area have been successfully established in the Rastatter Rheinaue. These trees have now been growing for more than 15 years in the floodplain. The parent trees in Kühkopf, more than 80 years old, seem to have established a resistance to the Dutch Elm Disease, where only 20% are sick, and most seemed to survive the first wave of the disease in the 1970s. There is an increasing suspicion, that trees growing in floodplain environments are probably more viable than others. But, evidence for this conclusion is still needed and research could lead to a major breakthrough in combating the disease, and likewise demonstrating the value (ecological as economic) of floodplain forests. The conversion of the forest into a more natural forest has been widely accepted by the landowner, Rastatt town.

- **Water**

The fords have been well established and accepted. The discharge and flow through the floodplain has already been improved by this measure, which increases the water level and longevity of the flooding in the floodplain. They have slightly enlarged the area of flooding, which now reaches some parts of the forest more regularly, that were formerly very rarely influenced by floods. There has been no further monitoring to follow up on the success of these improvements in the water management, so unfortunately no effects on biodiversity could be reported on.

Constraints

A major constraint in the implementation remains the fact that each restoration step is reliant on the goodwill of the owner and the legal authority, the council of Rastatt and the regional district. The relationship between WWF and the council over the course of the years has certainly improved, but the authority is still progressing only slowly on the issue of restoration.

Ecological Benefits

The improved hydrological situation of the floodplain will serve to reduce the danger of flood peaks. Firstly, the retention area has been increased, and secondly the development of the natural vegetation is more able to disperse the peak flood. This of course will only work if the example set in the Rastatter Rheinaue is taken up by other communities in the river valley.

Economic Benefits and Costs

The economic value of the forestry is still high, but the reduction of forestry practise will decrease the economic input for the town. On the other hand there are doubtless advantages on a larger scale for the larger community, well beyond purely the town of Rastatt. If the example of the floodplain reactivation in the Rastatter Rheinaue is taken up by other communities, it might help to reduce future damage caused by high floods. The economic value of these achievements is difficult to assess, but by bearing in mind the costs caused by flooding damage in recent years (1992-1994), the value is clearly there.

In addition to the reduction of high floods, the value for recreation is well recognised and has been widely promoted by the communities. The initiative to create and maintain a cyclist's path from France is one such example. This initiative is funded by the EU PAMINA programme under the INTERREG/PAMINA programme of the EU. The INTERREG/PAMINA programme combines the two Länder Rheinland-Pfalz and Baden-Württemberg with the neighbouring region of Münchhausen in France into one zone of common administrative planning, for the benefit of joint social, ecological and economic targets. With the integrated Rhine Programme (IKSR), the four Bundesländer: France, Switzerland, Luxembourg and The Netherlands came together to agree upon water retention, and other measures, in case of an emergency. There are no long-term plans as yet to implement a common strategy of increasing the water retention over the entire river valley.

The new Rhine Convention (1999) aims for a sustainable development of the river and its floodplain. As part of this global goal, a Rhine Atlas has been drawn up, to promote the establishment of a river corridor of connected habitats. It is planned to link this work with that of the Hydrology and Floods WG, for the sake of the revitalisation of former floodplains and for flood retention purposes. The WWF Floodplain Institute is the key player for the proposed ecological flood and river management.

Conclusion

Disastrous flood events, like the Christmas floods in 1992, 1993, 1994 and 1999 helped raise public awareness about the vulnerability of the River Rhine. The connection between the high floods and the need for retention is gradually being accepted and understood by the wider public. Future projects will come across fewer constraints in this respect, following the experiences learnt here.

Apart from the observation of the progress in tree growth, there is only a small amount of monitoring in the floodplain. It is urgently recommended to repeat a survey of the terrestrial and aquatic vegetation, birds, amphibians and selected groups of invertebrates, such as Carabid beetles, and also to provide WWF with the necessary funding for that monitoring. A survey of these taxonomic groups would provide an assessment of the relative success of the changes in the Rastatter Rheinaue, and would highlight the possible ideal and expected future changes. This assessment would then provide an insight into which aspects have improved or deteriorated, providing a basis upon which to react.

The results will have major implications for many other planned restorations along the River Rhine Valley and for other areas. Monitoring is particularly important, as the site will serve as a model for the projected restoration of the Danube near Ingoldstadt (Bavaria) and in Bulgaria.

Acknowledgements

I would like to thank Karl Gutzweiler (WWF Floodplain Institute) for his time and for guiding me through the floodplain forest and demonstrating the project. Thank you also to Erika and Eckbert Schneider (WWF Floodplain Institute) who contributed valuable additional information.

References

Köppel, Chr. (1997). Die Großschmetterlinge der Rastatter Rheinaue: Habitatwahl sowie Überflutungstoleranz und Überlegungsstrategien bei Hochwasser. Dissertation. Neue entom Nachrichten. Marktleuthen.

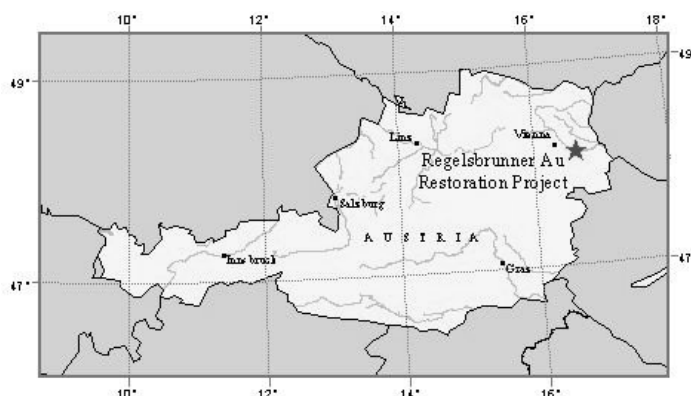
Späth, V. (1985). Vogelwelt und Waldstruktur: Die Vogelgemeinschaften badischer Rheinauenwälder und ihre Beeinflussung durch die Forstwirtschaft. Orn. Jh.Bad.-Württ. 1: 7-56.

2.2.8 Regelsbrunner Au Restoration Project

Description and Context

Location

The WWF restoration project is located on the south bank of the Danube, between the villages of Haslau and Regelsbrunn, east of Vienna. The project area is about 10km in length and 500ha in total area, 411ha (approx. 80%) of which, is within the Danube Floodplain (Donau-Auen) National Park. The project area is owned by WWF. 16°38'E, 48°07'N. See map (Figure 2.9).



Background

The Danube has a long history of regulation and damming. The first regulation started as long ago as 1883. Over the years, the river has been increasingly altered by human interference. Canalisation reduced the open water area between Maria Ellend and Regelsbrunn from 191ha in 1914 to 80ha in 1990. Equally as important, the area of open gravel banks was reduced from 63ha to just 3.4ha over the same time period. Along the first 1,000km of the river, there are currently 58 dams from its spring in the Black Forest to the Slovakian-Hungarian border. The last remaining stretches of free flowing water only exist near the mouth of the River Isar in Bavaria, in the Wachau and east of Vienna, where after a long struggle, this project site was officially protected in 1996.

One of the last major plans of interference was to construct a dam for the Hainburg Power Station. In late 1984, after the first trees were felled to make space for the dam, thousands of people from all over Austria, including activists from WWF and people from abroad occupied the area. These people protested for several weeks, to prevent the clear cutting of the trees. With Konrad Lorenz, WWF won a famous ally against these plans. Later that year, the police used dogs and batons against the demonstrators who were defending themselves and the trees from the clear cutting. Pictures of this were sent out all over the world, and in every province demonstrations started against this development. Just before Christmas, the Austrian chancellor suggested a moratorium. Several government commissions declared the region as worthy of being declared a national park. After a long struggle, through which WWF Austria became a powerful force, the Danube Floodplain National Park was announced in 1996.

Habitats

The floodplain mainly consists of hardwood floodplain forest (330ha) and 80 ha is occupied by the old arms of the river course. The majority of the forest is artificially planted hybrid poplars. Gravel banks and sandy river cliffs were formerly a common characteristic feature of the floodplain, but today, these habitats only exist marginally. Despite this, the project area is still the major area in Austria for this type of habitat, with high numbers of Kingfishers *Alcedo atthis* breeding in the area.

Biodiversity

Table 2.8: Key species in the Regelsbrunner Au

Taxonomic Group	Species
Flora	Black Poplar <i>Populus niger</i> and Silver Poplar <i>Populus alba</i> , Wild Vine <i>Vitis sylvestris</i> .
Invertebrates	Among the rich and diverse fauna, in particular are freshwater mussels such as <i>Unio spp.</i> , and others such as the rare snail <i>Lithoglyphus naticoides</i> which can still be found in the area. Among the many dragonflies and damselflies, the Banded Agrion <i>Calopteryx splendens</i> is the most obvious and characteristic for floodplains.
Reptiles	European Pond Terrapin <i>Emys orbicularis</i> .
Fish	With about 60 species within the National Park and 48 within Regelsbrunner Au, the area is the second richest in diversity in the River Danube after the Delta itself. The fish fauna consists of Sterlet <i>Acipenser ruthenus</i> (the last Sturgeon in the Upper Danube), Nase <i>Chondrostoma nasus</i> , Wild Carp <i>Cyprinus carpio</i> and three species of Perch: Schraetser <i>Gymnocephalus schraetser</i> , Streber <i>Zingel streber</i> and Zingel <i>Zingel zingel</i> - endemic to the Danube and severely endangered. The estimated fish biomass in the area is 2000kg/ha in the old arms of the river.
Birds	Little Ringed Plover <i>Charadrius dubius</i> are breeding on the gravel banks, a Grey Heron colony <i>Ardea cinerea</i> , White-tailed Eagle <i>Haliaeetus albicilla</i> (spreading, not yet breeding), Black Stork <i>Ciconia ciconia</i> are found in the area. Sand Martin <i>Riparia riparia</i> and Kingfisher <i>Alcedo atthis</i> are breeding in the river cliffs. The Kingfisher is the characteristic bird for the area, with one of the highest densities in central Europe. The total number of observed and breeding bird species is not known, but certainly this is above 100, because the area is well situated along major migration routes, and generally abundant in floodplain forest areas.
Mammals	Red Deer <i>Cervus elaphus</i> (subspecies 'Auhirsch') are common, European Beaver <i>Castor fiber</i> (introduced in 1975), Otter <i>Lutra lutra</i> are very rare.

Land Use Prior to Restoration

Intensive forestry was carried out with hybrid poplar plantations. The area was heavily used for this forestry until 1989, when WWF purchased the majority of the land. This consisted of 330ha of forest, 60% of which was covered by hybrid poplar, and had been a model forest system, harvested for the past 20-25 years.

Current Ownership

The land was acquired by WWF Austria in 1989, including the fishing rights. The former owner Graf Carl Abensperg-Traun sold the 411ha forest. A huge donation campaign raised the necessary money, with the additional help of television galas.

Protection

The area forms part of the Danube Floodplain National Park. It was opened on October 27th 1996 and covers an area of 9,200ha. Reglsbrunner Au consists of 411ha of WWF owned area.

Threats (past and current)

It was thought that the floodplain was drying out. However, the reduced flow of water in the river was actually due to the build up of sediment layers through the years, raising the area rather than it actually drying out. These layers have been established due to extreme high water events, and there was no chance that the old flooding regime of the river would clear them. Sedimentation has also occurred due to regulation of the river and the loss of natural erosion in the floodplain. Some river bed erosion has also taken place, partly due to navigation in the river. Previously, the area was overexploited by fishing. Fish have also regularly been introduced purely for fishing purposes, which overpopulates the river and upsets its natural balance.

The presence of dams up and downstream continues, acting as artificial barriers for migrating fish and other species. They are also the source of irregular water schemes and unwanted deposits from cleaning activities at the power stations. The Gabchikowo Dam, which received strong opposition, was still built only in recent years. This dam causes noticeable deleterious effects to the fish fauna, as local fishermen have confirmed. The first dam that is located after the Slovakian border (further downstream) also prevents the passage of fish up and down stream.

Restoration

Objectives (goals)

The major goal of all the restoration efforts is to allow the Danube water into the floodplain on a more regular basis, in order:

- To get the floodplain "breathing" again;
- To clear off old sediments and enhance erosion;
- To improve the natural dynamics, creating diverse habitat structures;
- To improve the breeding grounds for fish;
- To establish conditions for rare and endangered freshwater invertebrates;
- To set an example for other areas along larger rivers in Europe.

Approaches

The approach is conventional, with the purchase of land before the restoration can begin. But, because of its particular history and publicity, the project has always been well accompanied with interest from the wider public, which served as an invisible presence and consideration in any discussions. To overcome the major problems of there being so many people with different interests involved in the area (applying psychological constraints), it was initially seen as indispensable to integrate all players in some way or another. In particular, for the fishermen, it seemed important to involve them on a regular basis. A round table discussion was established, which evolved into a regular and important event in the planning process, and became part of the restoration approach. Additionally, the WSD (Waterways administration) became more and more involved, becoming a major partner along with the National Park Authority.

Activities

Construction

The project on the Danube at Regelsbrunn, is one of the larger enterprises carried out since river restoration began all over Europe. Three years intensive planning was necessary before the first sod could be turned in 1996. After more than 100 years of control, these first steps of restoration were started. The construction work finished in 1998. Together with the planners of the Danube Floodplain National Park and WWF, the Waterways Administration (WSD) is reconnecting the Danube to its old side arms in the floodplain, allowing more water into the Regelsbrunner Au.

By cutting 5 openings (which combined, add up to 160m in length) in the embankment, the old river course system (the river arms) of the Regelsbrunner Au has been reconnected to the main Danube channel. This once again allows the flow of water back into the floodplain.

Two other major techniques have been chosen to open the embankment. By lowering it by 1.5-1.8m at the 'Sweet Hole' near Haslau, this has lead to an increased water flow in the Regelsbrunner Au on 152 days of the year. Another technique has used special inlets in the dyke which promotes the water to flow for up to 222 days per year, whilst still allowing access along the embankment for walkers.

In order to further improve the situation inside the floodplain at 5 other locations, the traverses (footpaths and roads) have been lowered by up to 1.5m to improve the free flow of water.

Forestry

Forestry and other land uses stopped to enable the substitution of the hybrid poplars. On a few selected sites, the cutting of the poplar trees within the plantations, in 30m x 30m chunks, using the 'Swiss Cheese' technique, was undertaken between 1990 and 1995. The trees were then left lying on the ground as no clearance was undertaken. Since 1995, only beavers have been cutting trees.

Hunting

Hunting has been completely abolished as a natural contribution to the interplay of succession and grazing. Scientific monitoring to assess the impact of wild deer grazing on the vegetation has been carried out. Its results suggest that a stocking density of 25 deer/ha is not too high. No hunting has occurred since 1997, due to these results.

Organisational and Legal Framework

The Waterways Administration (WSD) using funding of 30 million ATS from the Austrian Ministry of Economy, is carrying out the project. WWF, which owns the Regelsbrunner Au, has been the driving force for restoration, supported by the national park administration. WWF also provided scientific support to most of the questions arising from floodplain management. The University of Vienna and the Bodenkultur University are monitoring the impact of this management on the plants and animals.

Evaluation

Monitoring

The Department of Limnology at the University of Vienna has been monitoring the flora and fauna. The monitoring was set up to follow the development of the restoration, 2 years before and 2 years after its completion. This monitoring covers sedimentology, hydrology, water chemistry and physical parameters, along with vegetation, fish, amphibians, birds and selected groups of insects and molluscs.

The first year of observations after reconnection of the floodplain was in 1998. During the spring of 1998 following the completion of the construction work, there were no large flooding events, and

hence hardly any experiences could be gained from the first year following the restoration. During the May flood in 1999, high floods invaded the newly opened floodplain and future analyses will reveal any observation about the changes in topography and its impact on biodiversity.

Experiences

The completion of the construction work is still too recent to fully assess the results at this stage. But first observations indicate that the implemented stages are steps in the right direction. The Sweet Hole, one of the openings, has been widening. Initially, this opening to the old river course (side arm) was 10m in width, but has now widened to a width of 70m. Also, the first small river cliffs have been established during the spring of 1999 on a 300m stretch along the river. The newly opened channel through the Regelsbrunner floodplain varies between 1.5m and 7m deep, with 500-600 steep river cliffs along the old river course side arms. Gravel banks have increased considerably. Some of the trees that were cut down between 1990 and 1995 have been deposited elsewhere in the floodplain, via the new flooding dynamics, which is an important biodiversity issue.

Degree of Acceptance

At the beginning of the discussion about the reopening of the embankment, the main problem was the wide variety of different sectors with interests in the area (a psychological constraint), who were worried about any unpredictable changes to the floodplain. This was widely observed.

- **Fishermen:** A critical group of stakeholders in Austria is the fishing association, a politically very strongly backed lobby group, with a long tradition. There was a lot of concern from this group in the beginning. WWF started an initiative to incorporate all the different views and interests in the project area, and created a round table discussion on a regular basis. This started as early as 1991 and continued after the restoration had been implemented. The discussion also focussed for a long time on the technical side of the opening. At present, the fishermen very much support the project and they can see the advantages of allowing the water into the floodplain, along with the cleaning of the old river channels.
- **Conservationists:** Some of the conservationists, in particular those concerned about some of "their" species, articulated concern and were afraid that the major changes into a highly dynamic river floodplain might threaten some of the beloved species. This rather static viewpoint was shared by many photographers, who also feared they would lose well known sites of interest.
- **Hunting sector:** There are no problems because outside the restoration area the hunting is regulated by the State.
- **Forestry:** The state owned forestry feared losses of timber, and asked for compensation.
- **Local people:** There was a lot of fear at the beginning, due to many perceived horror scenarios. This related to the fear of change. But, due to a steady accompanying publicity campaign by WWF, with the motto: "Wasser in die Au" (water into the floodplain), the planning of the restoration was widely accepted, particularly by the local people. A lot of the initial fears turned into broad support.
- **General public:** Generally supportive.

Another experience that appeared unusual for WWF, was the great publicity attention that this organisation was paid because of this restoration, compared to its other partners in the restoration. This could lead to envy and may lead to friction, which has happened in the past. A way to avoid this is to integrate all partners as often as possible, and also to actually allow them to gain from the increased attention that WWF Austria is benefiting from at the moment. This will considerably improve the relationship with the partners, for the sake of the project.

Constraints

The decision to build the Gabchikovo Dam was a high powered political decision. After a long fight to prevent its construction, unfortunately it was eventually realised that this struggle had been in vain. The effects that this dam has had e.g. on the fish population, must be considered as a major constraint.

RNW Regulierungsniedrigwasser (Regulated low water demand) is a law which ensures that the level of the River Danube near Regelbrunn, does not fall below a minimum depth of 2.5m for at least 320 days of the year, for shipping purposes. So far, this does not seem to have been a major problem at the project site. But this level might indicate the possibility of potential problems at other sites along the Danube, and indeed in other rivers with shipping (as in the Danube Convention).

In some instances, fine sediments are deposited all over the floodplain. This event is occasionally so strong, that a layer of fine sediment covers all the vegetation. This occurs when cleaning exercises are carried out at the power station upstream, in order to remove the build up of natural sediments from in the dam. This procedure is not illegal.

The complete prohibition of any hunting led to some constraints for the district government, which is obliged to ensure that some hunting by law is implemented. In this respect, the law needs some adjustment in line with the new objectives and situation in floodplains

Ecological Benefits

A healthy floodplain requires it to be connected to the main river channel. Previously, the floodplain area was only inundated for 22 days per year. The sediments, mud and sand remained in the floodplain and choked the old arms of the river course. The work being undertaken will increase the inundation of the floodplain by up to 222 days, while its 'real force' will be felt for 152 of these days. This will clear a lot of old mud and sand layers deposited over the years in the old stretches of the river course, and the reinstated dynamics will create gravel and sand banks, steep fresh river cliffs, and slightly overgrown banks.

The migration routes for fish will at least partly be improved. For seven months or more, they are able to pass into the floodplain and into the side arms. The re-opening of the floodplain also greatly improves the chances of re-establishing other typical limnofauna.

More Kingfisher and Sand Martins are present, in response to the increasing areas of river cliffs. The water is now flowing, so beavers have started building dams again, which is also beneficial for other species. More herons have colonized, because the area is now much quieter.

Economic Benefits and Costs

The land purchase, including fishing rights was set at about 80 million ATS and the restoration work cost approximately 30 million ATS, including the monitoring. In addition, there were personnel costs. Clearly the project is one of the most expensive, but the benefits will certainly pay off in the long run. The costs for the planned Hainburg Power Station have been saved, because it was not built, but the cost-benefit analysis estimation is not feasible at the moment.

The economic benefits will be seen in an increase of fish yields, in the regeneration of fish breeding grounds and in an increase of recreational opportunities.

Conclusion

In the first place, publicity was WWF's major means of preventing further destruction of this sensitive floodplain. Secondly, the high publicity enabled WWF to achieve a restoration project of a scale unique in Europe, and possibly in the whole world. But, it was not only publicity via media. It also

paid off to consistently assist and involve the stakeholders and all the different players involved in the planning and implementation process, within round table discussions. It is important to mention that a project of this scale has many players and many winners, not only WWF. Other players, including a modern and open waterway administration, eventually turned opportunities into successes, but it was WWF who was the driving force. WWF gained a lot of attention and has achieved one of the major successes in river restoration. This will bring WWF under obligation to ensure that continued successful progress and appropriate monitoring of the project is carried out. This will provide the basis for a successful continued detracting from river control measures and a focus toward the implementation of restoration methods.

Acknowledgements

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References

WWF, WSD & Nationalpark Donauauen (1997): Donau, a restoration -Gewässervernetzung im Nationalpark Donau-Auen. 19p.

2.2.9 Ringfurth (Elbe) Restoration Project

Description and Context

Location

The project is situated in the Magdeburg region, north-east Germany, and covers many aspects of river restoration on the River Elbe. The major activities are situated in the area near Ringfurth, close to Magdeburg. 11°46'E, 52°19'N.



Background

The project began about 5 years ago to promote river restoration along the middle basin of the River Elbe. This part of the Elbe has been designated as a Man and Biosphere Reserve "Mittlere Elbe" since 1979, and part of the National Park programme of the German government, which designated the most northern part only in 1997. Despite a large amount of legal protection, the river still faces many threats. Major problems include the impacts caused by an increase in use by ship transport on the increasingly used link between East and Western European destinations. Plans to widen the river and reconstruct the watercourse for larger ships would certainly put great stress on the ecological value of this still, uniquely unspoilt large river system, located in the centre of Europe.

The project is defined by 6 partial projects. Only two of these are considered in this review, as they cover certain aspects of river restoration, which have not been mentioned in the other restoration projects. As the experiences are still only very recent, only the first results and experiences of the project can be highlighted.

Restoration

Activities

Restoration on former army sites:

Certain areas along the River Elbe floodplain, near Ringfurth, have formerly been used as a base for Russian Army exercises. Due to this military activity, the site was heavily disturbed, so hardly any vegetation remained and the soil was compressed due to heavy vehicle transport.

The first restoration activities started about two years ago, when the first seedlings were planted in the area. These plants did not grow very well. The soil was still too compressed and a special device was

needed to decompress the soil. Special equipment from Australia (used there to drill rocky ground for Eucalyptus trees) was imported to dig up the soil prior to any further planting. This equipment has been very useful, and it seems that after 1½ years most of the seedlings have started growing. These experiences gained from this activity are very useful in relation to the knowledge that can now be used to aid the restoration of other sites inside and outside the floodplain, where there is a need to improve formerly compressed soils. Various scientists, in close collaboration with the University of Magdeburg, have monitored the development of the vegetation in the planted sites and also in unplanted areas that were left to allow natural successional processes to take place. These sites have been compared with existing areas of 25-30 years old natural succession adjacent to the project areas.

Navigation:

A major threat to the River Elbe is the increasing transport of larger ships along it. To avoid the increasing conflict, and furthermore to enable the water transport to develop into a more environmentally friendly form of transport, the restoration project initiated the idea of promoting alternative routes along a particular 240km stretch of the river. The Elbe-Seiten Canal is an already existing artificial watercourse used for transport purposes. It is proposed to extend the canal length to enable the navigation of larger ships, and in return stop the need for any maintenance on the 240km stretch of the river. The major maintenance of the river is carried out by groins, the purpose of which is to make the river more easily navigable for the larger ships.

The current problem is the lack of any official agreement yet. There is a memorandum of understanding between the NGOs and the ministries to extend the canal, but an agreement to categorically cease the need of maintenance along the river is still due. WWF managed to agree on minor issues. On five points they agreed with the maintaining authority to build a passage into the existing groins. This was to stimulate the natural erosion and deposition processes of the river in order to create more natural river dynamics such as slip-off slopes and steep river cliffs, because of a more freely flowing river.

It has already been demonstrated that even these small changes have a positive impact on the natural dynamics and the erosion and sedimentation has been promoted, which has provided many species their breeding habitat, particularly Kingfishers *Alcedo atthis*. In addition, typical river damselflies such as *Calopteryx spp.* have since established at various sites. These results are promising and it will be exciting to see what results will come about when the major river maintenance is completely stopped.

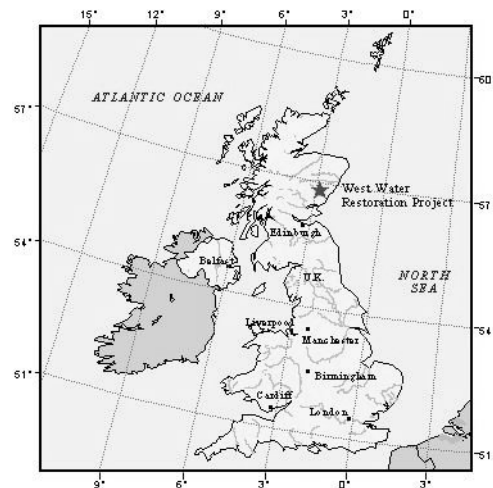
It is hoped that an appropriate monitoring system will be included throughout the implementation of this interesting aspect of the restoration. A review in about five to ten years could reveal important lessons for many other river stretches in Europe.

2.2.10 West Water Demonstration Site

Description and Context

Location

The demonstration site is on the West Water at Blairno Farm near Bridgend, Angus, Scotland, in the North Esk river catchment, at 2°50'W, 56°50'N. See map (Figure 2.10).



Background

The Wild Rivers Demonstration and Advisory Project was established in 1997 by WWF Scotland, to promote a greater awareness of the need for more sympathetic management of rivers and their neighbouring land. The project was initially designed for a three-year period and has now been extended to the end of November 2000. It seeks to emphasise the lasting economic and ecological benefits of a more natural approach, and encourage partnerships between all parties with an influence on river management.

In order to illustrate some of the recommended techniques, demonstration sites are being established in a range of landscapes (upland, mid elevation, lowland and a forest site). The majority of the work to date has been carried out at the mid elevation site, the West Water at Blairno Farm, which is referred to at this case study review.

The restoration project is part of an EU funded scheme for so called 'Objective 5b areas', to which agricultural funding schemes under the EU apply. This includes this area of the Esk River Basin. The EU and WWF are each funding 50% of the total project costs. This project started in 1997 and is designed for three years.

Habitats

The site is dominated by unimproved and semi-improved grassland, but there is also a patch of semi-natural broad-leaved woodland, dominated by Common Alder *Alnus glutinosa*.

The river itself, is a small sized upland river with gravel beds. On the gravel banks on the outside of the bend in the river, regeneration of willow and alder is taking place, amongst the scattered scrubland. There is also a small ox-bow lake, which is an important feature because this offers an alternative habitat to the more frequently encountered riffle-run-riffle sequence, found in this type of small upland river.

Biodiversity

Vegetation

The dominating plant communities consist of *Holcus lanatus* - *Juncus effusus* rush pastures with *Carex spp.*, namely *Carex rostrata*. Adjacent woodland mainly consists of *Alnus glutinosa*, *Betula pendula*, *B. pubescens* and *Salix spp.* The aquatic vegetation consists of Water Cress *Rorippa nasturtium - aquaticum*. In total, 83 plant species have already been recorded.

Fish

Only 4 species have been recorded, Juvenile Salmon *Salmo salar*, Trout *Salmo trutta*, Eel *Anguilla anguilla* L, and Brook Lamprey *Lamperla planeri*.

Mammals

No surveys have been undertaken, but signs of the presence of Otter *Lutra lutra* have been noticed. Casual observations have revealed the presence of Water Vole *Microtus amphibius* and Weasel *Mustela nivalis*. Rabbit *Oryctolagus cuniculus* and American Mink *Mustela vison* are also known to be present.

Birds

Regular monthly surveys have recorded a list of 54 species, of which 10 are breeding, including the following indicator species: Common Sandpiper *Tringa hypoleucos* and Dipper *Cinclus cinclus*. In the adjacent flood plain, there are breeding records of Oystercatcher *Haematopus ostralegus* and Common Gull *Larus canus*. Wintering birds, apart from Dippers, include Grey Heron *Ardea cinerea*, Mallard *Anas platyrhynchos* and Goosander *Mergus merganser*. Six Red listed species of regional and national concern (with greater than 50% decline in numbers in the past few years) have been recorded. Four of these species have been observed at the site itself: Song Thrush *Turdus philomelos*, Spotted Flycatcher *Ficedula striata*, Bullfinch *Pyrrhula pyrrhula*, and Reed Bunting *Emberiza schoeniclus*, and two nearby: Skylark *Alauda arvensis* and Linnet *Carduelis cannabina*.

Invertebrates

There have been two separate surveys on invertebrates (see Table 2.9). The first survey in 1997 was a limnological survey based on three sample sites in the river, which also noted the aquatic invertebrates present. The macro-invertebrate community is typical of a well-oxygenated upland river with no indication of pollution problems. The second survey, carried out in August 1998, targeted particular terrestrial invertebrates only, hence the species list only covers a selected sample of the entire terrestrial invertebrate fauna present.

Table 2.9: Records of invertebrates on the West Water at Blairno Farm

Aquatic Invertebrates	Number of Species
Stoneflies	7
Mayflies	3
Caddisflies	9
Damselflies	1
Alderflies	1
Beetles	7
Molluscs	2
Terrestrial Invertebrates	
Carabid Beetles	16
Bumble Bees	4
Butterflies	3

The level of invertebrate species diversity is difficult to assess, due to the limited monitoring of this taxonomic group, but it is not inhabited by either locally or nationally threatened species.

Despite this, the West Water does contain a number of riverine species, characteristic of this type of river ecosystem, such as: Otter *Lutra lutra*, Salmonids, Common Sandpiper *Tringa hypoleucos* and the expected species composition of aquatic invertebrate fauna.

Land Use Prior to Restoration

The site was mainly grassland used for grazing. The area on the inside of the river bend has some open alder woodland with a grass understorey. This area was also grazed, providing cattle with access to the river for drinking.

Current Ownership

The majority of the Wild Rivers Demonstration and Advisory Project area is privately owned. In central Scotland, land ownership is typified by a mixture of farmers who either own their own land or are landowners who own large estates, which are divided into several farms, each managed by a tenant or manager.

The mid altitude demonstration site is on Blairno Farm, part of the Careston Estate, is owned by a major local landowner. It is farmed by a tenant farmer and his manager.

Protection

The site is not legally protected for nature conservation.

Threats (past and current)

All restoration work at the demonstration site is reliant on the continuing goodwill of the landowner and local authorities.

Around 50 years ago, erosion by the river on the outside of the main bend was deemed to be threatening a local road. A concrete wall was constructed to prevent any further lateral movement of the main channel's course.

Some dredging of the main channel has been carried out by the landowner. This has been in the form of removing gravel from the river bed to avoid any lateral shift in the river's course. It is also a widely held view by the river authorities that trees and branches overhanging the river may pose a serious threat of erosion, if they were to fall into the water. Thus, any such trees or branches have been systematically cleared.

American Mink *Mustela vison* are known to be relatively common in the area, and evidence of their presence has been found at this site. Trapping has been considered, but it is unclear how effective this approach would be on their numbers. Rabbits are a major problem in terms of preventing young sapling development, and it appears necessary to allocate a large proportion of the restoration budget to fence off certain areas, from which they are to be excluded.

Restoration

Objectives (goals)

The objective of the Wild Rivers Demonstration and Advisory Project is to improve the management techniques employed by Scottish landowners and farmers. Agricultural intensification over the last 40 years has had a severe impact on river ecology. Through providing advice on practical measures and grant opportunities, it is hoped to lessen this impact whilst recognising the importance of maintaining farmers' incomes.

The specific management objectives of the demonstration site at Blairno Farm are stated as follows:

- To demonstrate the potential for combining agriculture and conservation for mutual benefit;
- To reduce the impact of farming enterprises on the river, through reduced stock pressure and nutrient loads;
- To maintain and enhance the conservation and fisheries interests of the site. This is proposed, by increasing the variety of habitats, linking up existing habitat along the river, and encouraging native species;
- To maintain the stability of the river channel and reduce the risk of erosion, which will in turn, reduce the recurrent costs of mechanical restoration following damage caused by the river in spate.
- To evaluate the future benefits for the landowner.

Approaches

The central approach, which characterises this project, is as its name suggests, to advise on and demonstrate environmentally sensitive river management techniques. It differs from other projects in that it seeks to work in collaboration with the existing landowners and managers, thus avoiding land purchase. By encouraging farmers to adopt and copy the restoration demonstrated, it is hoped that this non-land purchase approach will have a positive impact over a larger area than would be possible on purchased property, as funds are limited.

Activities

In collaboration with regional farming advisers, such as the Farming and Wildlife Advisory Group (FWAG), WWF is presenting farmers with information about more sympathetic land management approaches. Mailings, seminars and visits to the demonstration sites are being arranged. Information is also offered on potential sources of grant funding which can be used by the farmer to offset the costs of any restoration work carried out. Possible funding schemes include the Countryside Premium Scheme or the Woodland Grant Scheme from the Forestry Commission.

Practical restoration activities have been carried out at this demonstration site on the Blairno Farm over the last two years. An open field-drain, carrying nutrient rich water has been diverted so that it flows into an area of marshy ground. The marshy ground will filter out many of the nutrients before the water reaches the main river channel. It will also improve an area of wetland habitat, thus increasing the diversity of the site.

Two planting schemes have taken place at the site. Following a successful Woodland Grant Scheme application, a commercial plantation has been established on 2.3ha of grassland. Oak and Ash are the two dominant species that have been used, with some Rowan and Hawthorn interspersed. A deer and rabbit-proof fence, to prevent damage to the young trees has also been erected, thus providing protection to the long-term investment within the site.

Alternative arrangements have been made for cattle, which used to drink directly from the river, causing damage to the banks.

Stones have been added to the exit of a small, trickling side stream, which has the effect of raising and maintaining the water levels in this channel for longer periods.

Organisational and Legal Framework and Management

The land remains under the control of its owner, but under Scottish law there are a number of other agencies, which have some jurisdiction on the activities that can be carried out. For instance, the local authorities or district council are responsible for flood control and can therefore carry out flood prevention measures when it considers them necessary.

There is no law in Scotland, which obliges landowners to maintain the rivers. But, only recently, a drainage scheme has been established for particular rivers, important for flood control, which needs to be maintained.

There are four relevant regional water authorities. i). The SEPA (Scottish Environment Protection Agency) acts as a governmental body and is responsible for water quality and pollution. ii). Aspects of biodiversity are dealt with by the SNH (Scottish Natural Heritage). iii). The local County Council Authority is responsible for any other issue related to river restoration, iv) East, West and South of Scotland Water Authorities, who are responsible for water supply and effluent treatment.

The Farming and Wildlife Advisory Group (FWAG) and the SAC (Scottish Agricultural College), farmers advisory bodies, also play important roles, but purely in an advisory capacity.

Local Salmon Fisheries Boards are concerned solely with the protection and development of salmon and trout stocks in Scottish rivers, and they can carry out work which they feel will benefit the fishery. In the case of West Water, it is the Esk District Salmon Fishery Board, that represents the interests of the fisheries. Their major interest is the maintenance of salmon habitats, and their role is set according to statutes of the stakeholders.

WWF has no direct control over the land practices, and so depends on the landowners to act on their advice. Ultimately, the responsibility for the management of the demonstration site remains solely with the landowner, his tenant or manager. In practice, activities are planned in collaboration with the WWF project officer, and carried out by contractors.

Evaluation

Monitoring

Extensive financial resources have been committed to the monitoring of the West Water Demonstration Site. The need for baseline ecological data, in order to quantify future improvements in the site was clearly recognised. A geomorphological survey has been carried out to assess the physical nature of the river. No mechanical intervention was recommended. Although the concrete wall was likely to have been a very obtrusive feature at the time it was constructed, there has been significant growth of vegetation on the side of this wall closest to the river. There is now a discontinuous line of young alder trees along this bank. Another geomorphological survey conducted here recommended that this wall should be left in place, as its removal would damage the vegetation and cause unwanted and unsuitable erosion for the farmers.

A vegetation survey was also carried out, and ten quadrats were marked out as long term sampling sites. A preliminary fish survey was undertaken using electro-fishing techniques, and invertebrate communities have been sampled using pit-fall traps.

Some continuous monitoring has been established. A survey of bird species present at the site is carried out on a monthly basis. Progress of the restoration work and development of planted trees is recorded, every three months with photographs.

The future continuity of monitoring activities is not guaranteed after the end of the current project, which is due to run for one more year. At present, there is only the monitoring of vegetation on

selected quadrats, and the monthly bird survey may not provide a sufficient basis to make an assessment of the relative successes from the implemented restoration measures.

Limnological surveys of the fish and invertebrate fauna are to be carried out in due course, but these monitoring results will not be available, within the time frame of this initial 3 year study.

Experiences

In principle, it is possible to arrange some sort of restoration with the landowner. WWF was able to convince the landowner and the farmers to co-operate in the project, to set aside some of their land for this purpose. The success of this co-operation still needs to be demonstrated in the long run, i.e. whether or not the new practises will continue to appear to be more beneficial for the farmers and landowners. Success is particularly envisaged for the long-term ecological benefits, caused by changes in land use.

It appears that it can still be difficult for WWF to bridge the gap between the goals of the conservationists and the needs of the farmers. Building and maintaining the relationships necessary, is very time consuming.

It also was difficult to identify the relevant contractors. Particularly due to the initial short-term nature (3 years) of the project, it is critical to choose knowledgeable and experienced contractors and partners to achieve at least some of the targets, to demonstrate the potential successes of such a restoration.

Constraints

Certainly, the short time available for the restoration is a major constraint to the project, and it remains to be seen what goals can be achieved in the remaining time available. The implementation has been carried out, but the monitoring is only undertaken in certain areas. Therefore this monitoring does not study all the relevant species, and is only on a short-term basis (i.e. during the first three years of the restoration project). The absence of farming advisors with a holistic view of land and water management and biodiversity issues has been recognised to be currently one of the major constraints for a breakthrough in river restoration in the project area.

The unclear situation on the financial implications of the changes that the restoration will bring about, is a major issue for local farmers.

Ecological Benefits

It is still too early in the operation of the project to expect large changes in species composition or populations at the demonstration sites. First observations indicate that the gravel beds are developing with the growth of trees.

Economic Benefits and Costs

The total costs of the West Water Demonstration Site project come to GBP 26,786, following the implementation of the major activities and monitoring up until the end of 1998. This covers GBP 6,583 for monitoring and ecological assessment of the site and GBP 9,700 for the project implementation. The rest has been spent on less tangible and divisible costs.

In addition, GBP 8,800 were supplemented by government grants and the SEPA (Scottish Environment Protection Agency) also provided limnological surveys worth GBP 2,000.

The value of the site has at least, increased considerably, not only because of the plantations, but also through the added measures of protection. It has to be demonstrated in the long run whether or not the ecological benefits will match with the economic ones.

Social Benefits

The social benefits of the demonstration sites are limited, as public access is restricted to these areas. Benefits of the project, as a whole, are more general and long term in nature. Clearly, the wider public will benefit in many ways, especially by the improvement of river quality in ecological terms. Water quality and access is only part of a wide range of ways to enjoy rivers.

Conclusion

Scottish rivers and farmland are mainly under private ownership. Hence, the approach with demonstration sites is appropriate to further encourage more and more farmers/landowners to adopt this restoration approach in the future. Initial interest shown in the project seems to indicate that this approach to achieve restoration on rivers on a larger scale is promising and definitely worth proceeding forward with, although restoration on private land seems to come up against limitations. It is a difficult task to achieve a balance between the necessary functions on private land and the needs of the ecosystems to recover from human disturbances and change. River restoration on private land and on farmland always has to seek a compromise between the optimal demands of rivers and the needs to continue a reasonable economic land use system.

Once the farmers or even more importantly the land owners have been convinced about the benefits, economically, socially and ecologically, the chances to increase river restoration and conservation in the floodplain on a large scale are great. At the moment it needs key farmers and spokesmen to be convinced. The activities carried out over the whole restoration project need a lot of accompanying publicity, which seems to be an ambitious task to be handled by just one person. At the moment this one person is responsible for the management and promotion of the four demonstration sites, which all have similar issues as those described here at the West Water site i.e. to promote the natural river management practices to land managers, along with the project management responsibilities of reporting and administration.

In addition, it is not clear what will happen with the site, its management and the overall project, when the funding stops in autumn 2000. In fact, the main objectives are deemed to fail if consistency is not ensured, and there is no possibility that WWF can commit itself further than the initial projected 3 years of the project, although future monitoring is being considered. It is very difficult to convince the landowners and all other players, including funding schemes, that the restoration is paying off, when WWF itself is not committed on a longer-term basis. Due to the limited time-scale and the ambitious plans of this project, it remains questionable, that after three years, all the project objectives will be achieved.

The monitoring programme has been extensive on the West Water site, aimed at highlighting to those managing the land the number of species (visible and less visible), as well as assessing the possible ecological benefits of the restoration. Unfortunately, in the time that the project has been designed for, it will be unrealistic to document (accurately) any changes, though the baseline data gathered will form a useful reference if funding for future monitoring can be secured. According to the main aim of the project i.e. to function as a model, it seems that it would be useful to monitor how many restoration projects have been initiated due to the presence of the demonstration sites. This would document the success of the demonstration sites approach, and their value as an appropriate model for similar sites in Scotland, and most likely for other countries in Europe. It should be in the interest of WWF, to use this opportunity to multiply its experiences from this new approach, and monitor its successes as widely as possible.

Acknowledgements

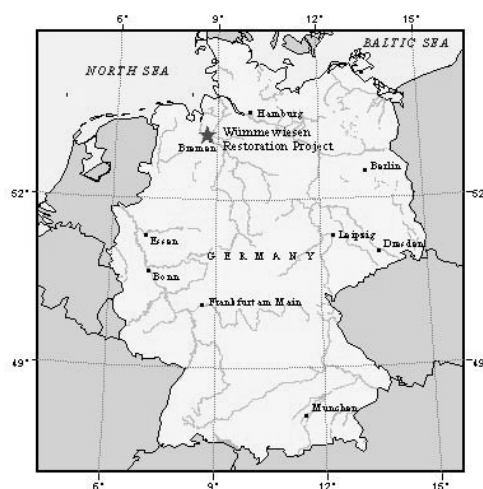
I would like to thank Steven Bell for providing me with the opportunity of a day's field trip in the project area and for his introduction about the project.

2.2.11 Wümmewiesen Restoration Project

Description and Context

Location

The Wümme is a right-hand tributary of the River Weser, confluencing with the River Hamme at the Lesum in north-west Germany. The project area is located on the river, which forms the border between the Land Bremen and Land Niedersachsen (Lower Saxony). The WWF project focuses on the Bremen side of the river, but activities in Lower Saxony will be included in the report as appropriate, because they have also recently started restoration work there, and there are strong links with the WWF project, providing unique opportunities for comparison. 8°44'E, 53°10'N. See map (Figure 2.11).



Background and Context

The River Wümme springs in the Lüneburger Heath and flows for about 156 km through glacial, alluvial sands and low fenland. Before confluencing with the River Hamme, it forms a large inland delta for 20 km on its course, and then flows into the River Weser. It is in this inland delta where most transformations and alterations of the river and floodplain have taken place over the last one hundred years.

The major aim of the long lasting meliorations was to improve the farming conditions on this fertile fen soil. Between 1928 and 1932 intensive activities in the inland delta changed the river course dramatically. Up to 80 small branches in the delta were transformed into three major branches and a few other channels. The activities continued in the following years and culminated in the enlargement and channelisation of the southern branch in 1971/72. Further attempts to continue with the melioration on the northern branch resulted in the first major confrontation between the water authorities and nature conservation organisations. In 1981, the conservation site seemed to have succeeded in halting further river regulation in this area. Due to this initial success, the conservation NGOs stepped in, strengthening and demanding further protection.

The authorities in Bremen made the first major political step towards supporting protection in 1981. However, it was only in 1987 when a major portion of its part of the river and its floodplain was eventually designated as a protected area. The major local NGO, the BUND Bremen, was asked to jointly manage the new project with WWF Germany. With financial support from the federal government and the Land Bremen, WWF purchased land along the Bremen side of the river and in the floodplain, and managed the extensification of the land use in the 677 ha floodplain area. In Lower Saxony, the river and the floodplain is still not legally protected, although it has been purchased by the responsible regional district Landkreis Verden with funding support from the federal government and the Länder Niedersachsen, in order to allow restoration of the river on a large scale. Landkreis

Verden has been responsible for implementing a nature conservation project on the Lower Saxony side. This is under the same funding scheme as the WWF project, and is sponsored by the federal government.

In early 1986 when the river authorities were carrying out their regular control of the embankment (a frequent maintenance measure), they decided to continue to cut down the trees which were reaching too far across over the river. Both the responsible river authorities and bodies from both Länder agreed to cut the trees along the river embankments. But, some of the trees in Land Bremen were growing on land that already had been purchased by WWF. WWF, in alliance with the BUND Bremen, argued on behalf of a natural development of the river bank and refused to permit any action of maintenance on their property. It was only after long negotiations and the legal back up of the Ministry in Bremen, that finally WWF and the water authorities agreed upon a compromise. This ultimately led to the construction of a new river channel called Sleepers Wisch, bypassing the area of concern, and hence in the process, helped to preserve the trees along the original river course.

Habitats

The Wümme (in the project area) is a typical lowland river, running almost exclusively through wet grassland on fen mire, with scattered sandy parts. The river is mainly fed by rain water, but still experiences some tidal influence due to enlargement measures along the River Weser during the last one hundred years. This leads to open sandy and muddy banks in the river, which are covered daily due to the tide and flood from rainwater. Although embedded by embankments (summer dikes), the River Wümme regularly floods into the floodplain during October up until late April, for an average of 60 days per year. This has a considerable influence on the farming and the vegetation, which is mainly dominated by wet grassland communities such as *Senecio - Brometum* and *Caricetum* plant societies. In very wet areas reed and rush societies dominate, and restrict land-use to only occasional mowing.

Along the river there is only a marginal band of river trees, mainly consisting of alder and willows, that are restricted in growth due to decades of river maintenance.

Biodiversity

The Wümmewiesen is probably one of the best-investigated areas with this habitat type. The first surveys of vegetation and birds had already started in the early 70s. Roosting and breeding birds have been surveyed almost annually since 1981.

For management plans on both sides of the river, numerous surveys and research initiatives have been carried out. The scope ranges from terrestrial and aquatic vegetation, soil parameters and fauna, up to higher taxa such as a large variety of invertebrate taxa, amphibians, fish and birds. Table 2.10 summarises the animal species that have been found along the river and in the floodplain during the last 15 years of monitoring.

Table 2.10: List of animal species surveyed in the entire Wümmewiesen project area (river and floodplain on both sides, approx. 1,000ha) according to Handke, 1999.

Taxonomic group	No. of species	No. of threatened (nationally) or rare species
Birds	197 (93 breeding)	43
Amphibians	5	2
Fish	31	17
Butterflies	27	5
Moths	230	54
Caddisflies	55	7
Carabid beetles	122	33
Skaters	9	2
Water beetles	55 (incomplete)	5
Orthoptera	21	8
Stoneflies	9	2
Dragonflies/Damselflies	35	15
Mayflies	36	11
Spiders	100	6
Terrestrial snails	30	5
Aquatic snails	31	16
Bivalves	15	6
Crayfish	9	-
Leeches	9	-
Tardigrada	3	-
Sponges	1	-

It would be too comprehensive for this report to mention all the species. In the following, only a selection of characteristic and typical species will be mentioned. Among the mammals, the Otter *Lutra lutra* is re-occupying the area. More than 197 bird species demonstrate the site's enormous value for grassland and water birds. High numbers of grassland birds and wintering waterfowl still characterise the floodplain as an internationally important site. Among them are Ruff *Philomachus pugnax* and Corncrake *Crex crex*, which are nationally threatened breeding birds, which can be found in good numbers. Nationally important high breeding densities of Snipe *Gallinago gallinago* and occasional breeding of Montagues Harrier *Circus macrourus* also occurs, as well as Bewick's Swans *Cygnus columbarius* and Black-tailed Godwits *Limosa limosa* with important roosting and wintering sites.

Among the fish, the lowland river Wümme is particularly important for migrating species, such as European Plaice *Pleuronectes platessa*, Sea Trout *Salmo trutta*, Sea Lamprey *Petromyzon marinus* and Rook Lamprey *Lampeta planeri*.

Of the invertebrate fauna, the Carabid beetles are of significant importance, particularly the threatened and rare species. These are mainly distributed along the muddy and sandy river banks. Another group of invertebrates important for river habitats are the dragonflies and damselflies. Typical river species included the rare *Ophiogomphus serpentinus*, which has increased substantially in numbers in recent years.

Land Use

Despite the wet and difficult to work ground, much of the land has increasingly been farmed intensively, including the presence of increasing numbers of cattle, and the adoption of modern land use techniques, including the increased application of fertilisers and cattle slurry. The land was

drained and a large network of drainage canals and ditches had been maintained through the years. This has incurred a fair number of implications for the river quality. Only because of the first purchases of the Wümmewiesen in 1983 and the designation of most of the floodplain as a nature reserve in 1987, has the land use become more restricted and gradually changed into more environmentally sound practises.

The land on which the restoration took place has since been extensively used and managed, with one or two mowings per year, and for occasional horse grazing. These uses are quite similar to those carried out on the adjacent area in the entire floodplain. The area continues to be drained outside of the WWF owned land by small ditches, and the land is also embedded by summer dikes to ensure farming can still continue during the months when there are wet conditions and when the potential of flooding is present. The river was regularly maintained by cutting off overgrowing trees and maintaining the stability of the river embankment by using fascines and stone packages. In the wider area, the river has also been regularly dredged to deepen its bed, by removing large amounts of sediment.

Current Ownership

Currently all the area along the project area and most of its adjacent floodplain is within the property of WWF and the BUND Bremen. Almost half of the floodplain area further away from the river is in the hands of local farmers. Therefore precautions have to be taken, in order to protect the land use of private owners as well as the management of WWF's property. This is achieved by constructing new cradge banks (summer dykes).

Protection

Almost the entire floodplain with 677ha is protected as NSG (i.e. nature reserve IUCN cat. II) and about half of it is under the ownership of WWF and BUND Bremen (a local NGO).

The bank on the side in Lower Saxony has been completely purchased by the Landkreis Verden, and will be designated as NSG soon. Although the area is still not legally protected, the recognition of the area and funding by a nature conservation scheme, through a federal programme of nationally important sites. This aspect is legally binding and is an important step towards its future protection, and has aided the first activities undertaken at this river site.

Restoration

Objectives

Initially, the major goal was to prevent further destruction of the vegetation along the river and the embankments and to allow a natural succession to develop. But, with the opportunity of constructing a bypass channel and hence creating a river island with new habitat types other than just the managed grassland habitat structure, slowly ideas of different visions developed among the local and wider nature conservation community. For the first time WWF and local NGOs were put into a position of being able to decide how nature should develop on a small area, influenced by the dynamics of the river, with only a few restrictions concerning flood control to the adjacent floodplain and the side in Lower Saxony.

But, as the majority of the floodplain should remain managed to protect valuable wet grassland vegetation, there were also limitations to the nature conservation itself. The main objective, to preserve the wet grassland fauna and flora and to promote and continue to allow extensive agricultural use in the floodplain, meant there were clear limitations for the development of natural river processes over the whole floodplain. There was a need to take precautions in the form of cradge banks.

The following goals were defined first in 1988 for a small area of 6ha, and later in 1994, extended to about 40 ha in the adjacent floodplain area.

Protection and promotion of:

- Natural processes and dynamics
- Increased space for greater water retention, sedimentation and the re-creation of soils and topography
- Free passage of the river and its inhabitants without constructions or other barriers (long-term goal)
- Habitat improvement for key and target species
- Protection of key species

Approaches

To achieve any kind of serious hydrological restoration on the river it was first necessary to purchase the land. The traditional agricultural land use structure in the area has been created by centuries of drainage and battling against the water. Restoration ideas to reverse this ideology seemed impossible to achieve with the local people at the time. Without being the owner of most of the floodplain and along the entire embankment, most of the restoration objectives would not have been implemented. Hence the necessity for a rather conventional approach was used, but some opportunistic elements and those of an experimental approach have also been applied.

In fact, in a way, the restoration was initiated by the action of the water authority. The water authority with their notorious activities to clear the river, triggered a rethinking of the river maintenance policy by the administration in Bremen, which eventually lead to the first river restoration project in the north of Germany, to reverse the process of melioration and canalisation. Hence the restoration project also had some elements of an opportunistic approach.

The first stages of the restoration have been carefully monitored and observed well beyond the region itself, which has been accompanied by many hopes, but also by a great deal of scepticism. Fortunately, the restoration idea was politically well supported by the local government of Bremen, who was open to new approaches in ecological activities. In addition, the area was part of a special funding programme under the regional government.

Activities

The following activities summarise the events at Sleepers Wisch, the area where the first initiatives started in 1988. All other activities, which proceeded later, will be mentioned only briefly as they have only recently been implemented. Land purchase at Sleepers Wisch began in 1983 with the purchase of 16 ha of relevant wet grassland near the river. In 1985, WWF completed the land purchase with support of the federal and regional government.

There were two major activities undertaken along the Wümme. The first measure started in 1988, whereas the second much larger restoration started in 1996 which was completed only as recently as 1998. As the first restoration stage took place more than ten years ago, almost all experiences derive from those activities and the emphasis will be on this stage of the river restoration.

The major activities included:

- Removal of riprap from the river bank, consisting either of stones or fascines
- Moving the cradge bank a further 100m (on average) away from the river
- Flattening of the levee in parts
- Construction and connection of a new river arm (also described as a bypass), forming (in the process) a river island
- Reduction of the cradge bank height in parts along the river
- Establishing a passage for fish and other species

All these activities were carried out in 1988 and 1989. The connection of the new river arm to the river was delayed for one year to ensure that the summer dyke was stable, by allowing the grass to settle and grow on it for one season.

In addition to the measures along the bank it became necessary to improve the situation in the river. This included the reconstruction of dams and riverbed glides.

It also became necessary to set aside formerly used grassland, which now is under the influence of the natural dynamics of the river. This was possible as WWF and BUND Bremen were the landowners. Originally it was not planned to completely exclude agricultural land use. If the natural conditions of some areas allow it, it should be possible to mow and even graze the land with special cattle.

Organisational and Legal Framework

The project was lead and managed by WWF in close co-operation with the Ministry of the Environment in Bremen, the local governmental body responsible for the environment, and also for water affairs. This is a rather unique legal arrangement, not known in other Länder, and which is not applicable for the adjacent area in Lower Saxony. Although WWF is the landowner, the legal arrangement chosen for implementing the restoration was a decree under the water law, which enables WWF and the responsible authority to decide and act through a rather simple mechanism, without complex and long lasting consultation procedures.

The Wümmewiesen has been recognised as a site of national importance and included in the federal funding scheme. WWF began to receive funding in 1985 and is responsible for the budget, and also holds the responsibility for the entire project implementation and management. It has been agreed with the BUND Bremen (as the main local NGO) and the Ministry for the Environment, that all decisions will be taken in close collaboration. With both partners, agreements upon co-operation in all management issues, including restoration activities have been set up.

The part of the floodplain in Lower Saxony was also recognised as important in 1990. Here, the Landkreis Verden (regional district) is the budget holder and responsible for the project development. This will have major implications in terms of the joint responsibility of the river for the vision of the area. This is possibly of more importance than the actual designation.

WWF and the Landkreis Verden have elaborated a management plan each, which serve as the basis for all types of activity, the land management, and any other river restoration measures. The plan is legally binding and in accordance with the requests from the funding authorities.

Evaluation

Monitoring

A large scale monitoring programme was set up to follow the changes caused by the restoration. The programme covered terrestrial and aquatic vegetation, hydrology, limnology, fish, birds and terrestrial invertebrates. The programme was designed to consider the river and also the area of additional land that can be flooded, which was created following the retreat of the summer dykes.

Most striking of all was the recovery of the fish population. In particular, many young fish of different species have been found, and it is likely that parts of the restored areas function as breeding sites for the fish. Otter have been seen and its tracks can be found regularly on the river bank. But, as the species generally is recovering all over Europe at the moment, it is not entirely clear if the recovery is due solely to the restoration activity. Despite this fact, the species has clearly benefited from the increase of suitable habitats.

In particular, the second step of river restoration further downstream will precisely match the requirements otters need from a living river, but this still has to be seen in the near future. More

obvious is the success with the Kingfisher *Alcedo atthis*. Since the restoration in 1994, Kingfisher have been found to be breeding in the area adjacent to the activities, frequently seen fishing there, as there are now more favourable conditions in the restored part of the river.

Surveys carried out on the aquatic invertebrate fauna showed a distinct increase of rheophilic species in the years between 1989 and 1996. Mayflies and Caddisflies particularly reacted positively to the restoration. But, it has been noticed that parts of the new river arm regularly dry out, and not only in dry summers so many rheophilic species dependent on running water have not yet established in the area. The riverbed has been made smaller and because of this the sandy and muddy areas have gradually become overgrown and unsuitable for certain species that particularly depend on these substrates as their primary habitats. The fauna also still lacks other typical elements of lowland rivers, which can be explained due to the ongoing disturbances in the water level, strong sand shifts in the river bed and missing substrates such as driftwood.

Dragonflies, Damselflies, Carabid beetles and Orthoptera were investigated in 1993 and 1994. The surveys showed a clear positive response in many species compared to the 1987 survey. Stoneflies and Caddisflies have also recovered enormously. More than 15 species of dragonflies have been recorded in the area. Three typical river species benefited from the restoration, but most spectacular is the finding of one nationally rare and threatened species, *Ophiogomphus serpentinus* that was found breeding in the river for the first time, directly at the restoration site. Two typical lowland river species but were missing and *Gomphus vulgatissimus* was only once recorded. The river is still affected by too many disturbances and only a complete river restoration of the entire lowland will be accompanied by the presence of such dragonfly species. Not every type of monitoring can demonstrate so clearly, the relative success of the restoration project. Long term monitoring of the sensitive Carabid beetles also shows a tendency of positive responses of this group. Of 33 Carabid beetles, 22 species show a positive response to the restoration, and are in abundance. The restoration site may have already developed into one of the most valuable sites in the region.

Experiences and Constraints

The common border with two different Länder holds the disadvantage of administrative limitation, and prevented melioration work from being continued easily across the boundary. It also placed constraints on joint efforts in protection and conservation. The advantage of the Wümmewiesen side in Bremen is that this small Land has fewer administrative levels and a small agricultural lobby, meaning that the site is ideal for gaining the first experiences of river restoration from, a fact well represented also by the many other successful river restoration projects in Bremen. The legal arrangements for the two main responsibilities, namely, 1). nature conservation and water, and 2). flood control and its management, all within one ministry, helped a great deal in implementing the project. All former projects seemed to have failed due to different authorities not collaborating or agreeing on a common platform.

Apart from the already mentioned and well documented changes in the aquatic and terrestrial fauna, the changes in terrestrial vegetation have been accompanied with a lot of scepticism by many botanists. The area previously served as one of the last resorts of Marsh Orchids *Dactylorhiza maculata* and has been a typical example of a *Senecio - Brometum* habitat, but the vegetation changed rapidly into a less important *Magnocaricion* and *Phragmition*, possibly due to inconsistent water table changes and changes in the land use.

The hydrology of the entire river arm (Wümme-Nordarm) has not been changed at all from the restoration, due to unnatural changes in the water table, the shift in sediments caused by the canalisation and damming in the river and also because it is determined by the land use in the floodplain area.

Only in the context of the entire basin can a successful restoration be achieved. Major restoration goals have not been achieved for two reasons. One is partly due to the described difficulties of many responsible authorities on a river bordering two administrative regions with different decision structures. The other reason is linked with the complex hydrology left after a long history of

interference. The objective of a free passage along the river is also constrained by the conflicting conservation objectives. The transformation of any existing barriers into devices on the riverbed permitting passage, is principally ecologically better than any weirs. But, the latter is often still needed for maintaining high water levels in the floodplain, because of the past drainage and channelisation of the entire floodplain. This might be generally applicable for many lowland rivers.

The activities that started in 1998 on the Lower Saxony side of the river are very promising. Despite starting late they have restored the river on a much larger scale. A great deal has been learnt from WWF's first experiences, and a working group established between both projects ensured a necessary exchange of information. There are still many issues to be solved on higher administrative levels involving many different local and regional water and environmental authorities between both Länder. According to the rules, those lying further down river have to take the water from those upstream, which of course creates many differences of opinion. Due to the complex matter of the overlying hydrological constraints on the restoration projects on the Wümme, these circumstances have to be accepted, unless a solution can be found at a higher administrative level between Bremen and Lower Saxony.

There was also considerable resistance from some sectors of the conservation community towards the restoration project. Some members of nature conservation bodies and agencies argued that the main project aim should be to protect the nature area only in the context of its farmland, and that the protected area should remain as a man shaped landscape. The project management faced two views, with arguments also against any change in the river system. Conservation aims such as the re-establishment of natural processes in the river system were not only in discordance with local farming, but also with the vision of many within the nature conservation community, whose view was to protect biodiversity on farmland habitats. All further conservation activities had to take this premise into consideration.

Hence, initial plans to improve the river and its floodplain were solely restricted to the first land that was purchased along the embankment. Only after intensive, laborious and time consuming discussions was the management able to progress with the planning of the river restoration on a larger scale. The increasing discussion about free succession and the natural dynamics in various habitats all over Germany during the 1980's, prompted by the difficult economic situation for small scale farmers on extensive farmland, helped to envisage a new and more dynamic vision for the river Wümme and its floodplain. Hence, a rather static view of the river transformed into a vision of a more dynamic system, which considers the river as not just stopping at its bank, but to also take into account the entire floodplain area. Still, the right balance between the needs of farming and the natural dynamics of a river system that is highly susceptible to flooding needs to met. This is the most difficult task for the management in terms of planning and implementing any further restoration activities.

For the second step of the river restoration further down the river, in an area covering about 40 ha, the most important experiences were:

- To focus on the river itself, rather than in the floodplain, where most of the success has been observed.
- To focus on species which actually occur in the river system.
- To restore not too schematically.
- To appropriately delay the implementation over a longer period to encourage different succession stages in the same area.
- To use construction material (soil etc.) sympathetically and in an ecologically sound manner.

The latter point especially proved to be of considerable importance. Whereas the material from the first implementation stage was dumped well outside the floodplain area incurring enormous costs, the second restoration only removed soil from places where there were plans to create ponds or flattened areas. The material taken from these areas was stored, and then re-used the following year, or for other projects. The results and experiences gained have already demonstrated that this has been successful, not only in ecological terms but also in economic terms too. The implementation required

minimal transport and disposal, and a number of newly created habitats have been colonised by rare plants. Economically expensive disposal and transportation costs were saved.

Ecological Benefits

The long term monitoring clearly showed improvements in terms of the biodiversity (as discussed). Other benefits such as water purification could not be demonstrated and have not been investigated, but would not be expected as the project was carried out only on a small scale.

Economic Benefits and Costs

The costs of the entire project within the nature reserve were estimated at about 14 million GEM including the costs of management activities, with about 1.3 million GEM for personnel. Most of the money was budgeted for the land purchase of the whole area, and only partly for the area where the restoration took place. Almost 75 % of the costs were covered by a special funding scheme from the federal government to protect sites of national importance. More than 15% of the costs were provided by the regional government of Bremen, who also funded most of the first restoration activities in 1988 and 1989. The above mentioned figures cover the entire project, but the costs for the river restoration divide as follows (in GEM):

- Land purchase 900,000
- Planning 90,000
- Building 660,000

Economic benefits include the savings made by stopping cost intensive maintenance along the river in the long term. This issue is contentious, as every maintenance has been undertaken under the premises of economic food production. But indeed today, food production is no longer competitive, particularly so in wetland areas such as the Wümmewiesen, and any additional costs to maintain the summer dikes and secure dry grassland farming cannot be justified any longer as an economically viable option. Parts of the area have been rented out to local farmers, who use the land in a traditional way and mow the area once or twice a year due to the current water table. The economical value of this is higher than zero.

Social benefits

One of the biggest benefits gained is the model character of this restoration for further restoration activities in the area and in the adjacent neighbourhood. The neighbouring Länder Niedersachsen has already benefited hugely from the experiences in the Bremen restoration, and saved a lot of time and money by taking into account the constraints and lessons from the first stages of the restoration on River Wümme.

Conclusion

The restoration of a stretch of 600m of the Wümme river in Bremen, was one of the first restoration activities carried out in Germany with local and federal funding under the management of WWF, and was largely publicised well beyond the region all over Germany. Most of the results are well documented and published. The lessons and constraints have helped many other projects in adjacent and other areas to improve their planning and implementation of their restoration ideas.

Major constraints during the planning and implementation stages occurred, regarding the acceptance and support by local stakeholders, especially farmers. Due to the conventional approach taken in the restoration, these kinds of constraints had been expected and were tolerated. Modern restoration projects though, should put more emphasis on the acceptance of local people and stakeholders. At the time when the Wümme restoration began, during its first planning stages these approaches still had not been widespread or experienced elsewhere. Hence, at the time they seemed to be inappropriate.

The current continued success of the project is due to the strong political and financial support, which aimed to set an example well beyond the region, and this certainly succeeded.

The Wümme project also serves as a striking example how different visions can clash among the conservationists. Due to the political and financial aspects, a common vision could not be agreed in time before the first stages of implementation had already started. It was this rush that created a lot of tension. But hopefully, other up and coming projects could benefit from these experiences, by trying to ensure the integration of differing ideas as widely as possible, and from the outset of any project.

As the project still serves as one of the major and oldest restoration projects for lowland rivers in Germany, and beyond in north-west Europe, a continuation of the monitoring of selected species groups should be secured on a long-term basis. Monitoring at present is restricted by limited funding, but by monitoring biodiversity, this still serves the purpose of assessing the entire scope of changes in the ecosystem, including changes in hydrology and sedimentation status.

At the Wümme the development of fish, dragonflies and Carabid beetles along the shoreline should be part of a long term monitoring scheme, preferably embedded into a context of other monitoring programmes covering related WWF projects in Europe, or projects nearer to the region with a similar objective. Its results are of high value for WWF and its freshwater programme, but more so for the entire freshwater conservation community.

Lastly, the entire Wümme may serve as an ideal restoration model for many small scale lowland rivers that are heavily effected by various land use practises and changes in the hydrology. It would be worth considering this restoration in terms of embracing the entire river valley from its spring to its mouth in the River Weser. The Wümme seems to be an ideal example, because it is comparatively undisturbed, has already experienced a lot of restoration work and lastly, it is representative for a large area stretching from the Netherlands, over northern Germany, Poland and well into Eastern Europe. Each river has its own unique peculiarities so it is strongly recommended from the experiences of the Wümme, to firstly begin the restoration only of a comparatively small part. Then, collect and understand the first experiences and build the following steps upon these experiences. This approach will be ecologically and socially beneficial, and can save enormous costs.

Acknowledgements

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References

There is a summary of all published papers and unpublished reports about the Wümmewiesen in:

Handke, K. (1999): Zoologische Untersuchungen in den Wümmewiesen 1981 bis 1998 - ein Überblick mit Empfehlungen für künftige Erfolgskontrollen. Unpublished report. 49 p.

Further important literature includes:

Oertel, G. (1998): Gewässerrenaturierung in der Wümmeniederung bei Bremen. *Angew. Landschaftsökologie* 23: 19 -36.

Oertel, G. (1998): Fließgewässerrenaturierung und naturnahe Auenentwicklung an der Wümme. *Schr.-R. f. Landschaftspfl. U. Natursch.* 56 199 - 219.

3. Lessons Learned

In the following summary, focus has been on a limited number of issues, relevant for river restoration, which have arisen from all the case studies investigated.

3.1 Vision/Objectives

The objectives differ widely from project to project. The majority aim to increase the natural processes, while some seek to maintain or manage the open landscape. Others again focus on sustainable use and anticipate the mutual benefits for wildlife, biodiversity and local economies. Some try to combine a range of different and partly contradictory objectives, but succeed in maintaining a compromise on a fairly small area.

The regional environmental context of the project also seems to be of significance in determining the vision. In northern and eastern Europe (Ammarnäs, Biebrza), where in principle wilder habitat structures prevail or at least dominate in parts, open landscapes with their particular set of species are much more likely to become the major vision and drive for river and floodplain restoration. In southern Europe the opposite seems to be the case. In the Cap de Terme project in Spain it is the aim to plant trees in a widely dry and open landscape to prevent further desertification.

Table 3.1: Major objectives of the selected European case study river restoration sites

Objective	Case study sites
Natural Processes	Gelderse Poort, Wümme, Kühkopf, Danube Delta, Bislicher Insel, Regelsbrunner Au, Morava, Biebrza
Species Diversity	Wümme, Biebrza, Danube Delta, Regelsbrunner Au, Morava
Habitat Diversity	All
Sustainable Farming	Biebrza, Wümme, Morava (SL), West Water, Bislicher Insel
Sustainable local economy	Danube Delta
Sustainable Forestry	Rastatter Aue, Morava (A),
Sustainable industry	Gelderse Poort (Clay extraction)
Sustainable transport	Ringfurth
Wildlife corridors	West Water
Open landscapes	Biebrza, Ammarnäs, (Wümme)
Water availability and sustainable resources	Biebrza, Cap de Terme
Water purification and quality	Biebrza, Danube Delta, West Water
Flood control	Gelderse Poort, Rastatter Aue, Danube Delta, Regelsbrunner Au

After visiting some projects it became evident that one of the major constraints for the implementation is the lack of a common vision about the restoration goals. Often vision and expectations differ widely between partners and even between different members of the same organisation. It cannot be emphasised enough how important it is to agree on a common vision before implementing any restoration, in order to avoid unnecessary friction during the long process of planning, implementing and monitoring the river restoration.

Rivers are highly dynamic systems. Every eventuality from each approach to increase their natural processes cannot be planned in advance, and risks a high proportion of unpredictability. This is the major constraint for stakeholders and the local population but also for many conservationists, who at this point halt before the restoration starts.

3.2 Approach/Partnership

Different objectives naturally require different approaches. In selecting the case study sites one can distinguish seven different approaches (Table 3.2).

Table 3.2: Approaches in river restoration in selected European WWF projects

Approach	Description	Case study sites
Conventional approach	This approach is based on land purchase before planning and implementation. It usually involves a hearing and often is accompanied by compensation for affected stakeholders	Wümme, Bislicher Insel Regelsbrunner Au
Participatory approach	Participation of every stakeholder to finally agree on the restoration project	Danube Delta, Biebrza (Regelsbrunner Au)
Opportunistic approach	Taking advantage of events, such as high floods or political changes	Kühkopf Danube Delta
Partnership approach	Seeking for partners to jointly implement mutually beneficial restoration projects	Gelderse Poort Rastatter Aue Danube Delta West Water
Experimental approach	Trying new techniques in new scientific terrain with big involvement of scientific consultation, regional and international	Biebrza Wümme Rastatter Aue (oak tree plantations) Ringfurth
Holistic approach	Plan and implement the project in the context of the entire floodplain	Gelderse Poort
Model approach	Small demonstration sites with model character to demonstrate the benefits of restoration to landowners in order to encourage them to use these or similar techniques on their own land	West Water

The participatory approach, involving stakeholders, has often been proclaimed but could not easily be recognised in most case study sites. Real participation of all stakeholders only seemed to have taken place at the Danube Delta restoration project, where the local people fully supported the WWF restoration goals. In most projects stakeholders more or less have to accept the project objectives. They often adapt to them or avoid them and some form of compensation is often required. The conventional land ownership approach, involving purchase of private land is still the most successful approach to fully implement the restoration objectives. This is because river restoration science is still in its early stages so it is necessary to implement projects on purchased land. To demonstrate the ecological values of restoration, WWF started some projects on its own property or land owned by the public. If the emphases are on a change in hydrology and topography, large implications for stakeholders are inherent. A consensus with all landowners and stakeholders is unlikely to be achieved in the short term and considerable consultation efforts may be necessary before the preferred option for restoration can be agreed (e.g. Biebrza). Having said this, in some project areas that are largely the in public ownership, the targets only seemed to have been implemented reluctantly (Rastatter Aue), due to concern over the unpredictable changes often linked with allowing more and more natural processes.

It has been shown that this conventional approach to restoration through land purchase is still justified for many objectives in river restoration, with growing awareness, chances to restore rivers on a large scale have increased. It seems obvious that it would be impossible to purchase all relevant land (e.g. 1% of Austria, Heeb et al. 1999). New approaches such as those tried in Scotland under the Wild Rivers scheme sound promising in order to cover larger areas of private property. But at the moment,

most of the successful projects clearly have elements of the conventional approach and new approaches still need to prove their success.

Now, river restoration has become a widely accepted means to improve the quality of rivers and appears to have become a major key to combating increasing high flood events. More and more voices demand a holistic approach and try to scope for large areas in the basin or even try over the entire floodplain. Partners for river restoration line up and the partnership approach is highly advertised and high on the political agenda. Among the major partners are the authorities, formerly responsible for most of the melioration, which are now joining in and contributing, often with very valuable advice (Regelsbrunner Au, Wümme and Gelderse Poort). Other partners can be found in various stakeholders, like the clay industry in the Gelderse Poort or the fisher association at Regelsbrunner Au. Currently, river restoration (like many other initiatives in nature conservation) builds on partnerships, which is possible today due to an increasing public awareness and ecological understanding of the issues. Today, it also seems to be fashionable to design participatory projects. Many projects were actually participatory for the sake of participation, but it would be wise not to ignore any existing differing interests of some stakeholders, with the objectives of the river restoration. Projects only focussing on partnership are likely to fail, if they ignore the difference in interests. There are many attempts to try to integrate this, but not always under the ideal conditions. The Wümmewiesen project is one example, which mirrors the long history of varying successes in integrating the different interest groups. The round table initiative of the Regelsbrunner Au seems to be a good example of how to provide a forum for all people involved in the restoration process.

The successful partnership between WWF and the clay industry in the Gelderse Poort project demonstrates the possibility of jointly agreeing on common objectives and achieving river restoration with fewer constraints. It definitely is worth checking to see if this partnership can be copied for other project approaches. Difficulties in achieving this have been shown at the nearby Bislicher Insel project in Germany. It has to be mentioned at this stage that the gravel industry differs between rivers, regions and even varies along the same river. Generally it might be worth considering a partnership with the gravel industry, although their interest will remain problematic for an achievement of natural river succession. Nature conservation might gain more from compromises, agreements on 'no touch areas' and joint projects (where applicable), than by maintaining confrontation as in the current situation. WWF might pick up on this issue. Large-scale gravel extraction seems to be incompatible with river restoration objectives at this stage. But, it must be suspected that no real attempts have been undertaken to start communicating with this important conflict group and to encourage them to become a possible partner in the future. This of course is relevant and might become important for many river restoration projects all over Europe, such as along the Rhine, Elbe, Danube, Oder and others.

Only recently, as part of a more holistic approach, it was WWF (in particular) who initiated projects embedded into larger scale international trans-boundary programmes (Green Danube, Danube Carpathian Programme, Green Belt Oder Neisse and others). Projects that are part of this programme have become widely acknowledged and supported politically. They benefit by governmental and international funding schemes to cover the construction costs and to compensate economic losses caused by river restoration. The latest initiative by the Romanian government, which started the Lower Danube Green Corridor is very promising. All four countries in the catchment area of the Lower Danube are participants, including Bulgaria, Ukraine and Moldova. The countries committed themselves in spring 1999 to an arrangement under the 'Gift to the Earth' initiative of WWF, to designate wetland areas along the River Danube and to restore them by the year 2005. The generous budget of 35 million US dollars funded by the World Bank will cover all WWF's project proposals, which have been designed under the Danube Carpathian Programme.

Another approach involving all countries along the Rhine links each country initiative into one harmonised flood response concept. This concept, though only focussed on the flood control, does consider the entire river with all countries, including The Netherlands, Germany and France with a scheme of response to open certain polders along the river. Dister (1991) developed some ideas to implement ecological components into this concept, which includes aspects for biodiversity,

recreation and water purification. This ecological flood response concept has been appreciated but only implemented in fragments to date (e.g. Gelderse Poort in the Ooievaar plan).

On a smaller regional basis this model approach has been addressed to parts of Scotland as part of the Wild Rivers initiative. Several demonstration sites aim to convince stakeholders and land owners to take on restoration on their own land. The initiative is still too young to report on any successes.

Projects can have different approaches and some projects have a combination of two or three, which often complement each other. Table 3.2 summarises the seven approaches defined for this study.

3.3 Management

WWF has been an adviser, initiator, catalyst, mediator or manager or all of these in its restoration projects. The decision-making structure, based on financial and political power is rarely in the hands of WWF unless it is the owner of the area as in the Regelsbrunner Au, Morava, partly Gelderse Poort, and the Wümme projects. WWF can have good ideas, but they may never be realised due to an arbitrary decision structure and lack of transparency in distributing responsibilities. The responsibilities grow out of being the landowner but this can be another constraint for an organisation like WWF. The duties involved in looking after the property can be very time consuming and demand a large bureaucracy. It has already been considered in some projects to sell or give the land to the State or National Park agency. This delicate step might have major implications especially in respect to all the donors to WWF, and needs careful consideration in each case. The most successful projects have been those where WWF has been involved as a landowner and manager (Gelderse Poort, Wümme, Morava and Regelsbrunner Au). WWF was least successful, where their commitment was only for a limited period (Bislicher Insel). The strength of WWF is its good reputation it holds throughout all social groups, including stakeholders and its world wide acknowledged expertise. It will be crucial to achieve the right balance of involvement. It is certainly not anticipated for WWF to be committed in each project as a land owner and manager. The case studies show a variety of different successful approaches. In the Gelderse Poort project it has been demonstrated that the project can be very successful without WWF's involvement in the management. In the Biebrza WWF started the project in supporting the management plan with foreign expertise to find out about the best way in river restoration. Today a Biebrza project office of WWF has facilitated the research, consultation and technical planning work for the restoration together with other NGO's .

3.4 Monitoring

Ecological monitoring is still widely considered as being desirable although not totally necessary by project designers. Therefore it is often implemented reluctantly and incompletely. It is considered as a highly costly task, which is not of high priority. This is not quite represented by the projects selected in Table 3.3, although only four have set up an appropriate monitoring scheme to accompany the restoration process. The monitoring is usually organised by WWF (e.g. Wümme, West Water, Rastatter Aue) or partly (Danube Delta) or by partner organisations (Gelderse Poort) or universities and institutions (Regelsbrunner Au, Morava). Information about the costs is incomplete and dependent on the scale, coverage and region. For the small project at the demonstration site in the West Water project, the costs for surveying and monitoring were about 10,000 Euro, covering a large range of biodiversity, sedimentology and hydrology issues. For the Wümme project, the monitoring for the restoration has been carried out every three years up to date and covers most aspects of biodiversity (see Table 3.3) with costs of about 30,000 Euro.

The others have often an incomplete monitoring (Biebrza and West Water). There has been quite a lot of inquiry about the correct monitoring and there are still uncertainties about the type of taxa that should be investigated, the frequencies and coverage, in order to have reliable and comparable results. It might not be worth considering a common monitoring method, as the project objectives differ widely, but a common methodology most certainly would be appreciated. Important points are firstly to start the monitoring before the implementation, and secondly to ensure consistency during the monitoring programme and also of the organisation responsible for the inventory throughout the project period.

Monitoring did not only cover biodiversity aspects, but also hydrology and soil chemistry (main focus in the Biebrza project, Rastatter Rheinaue and in the Danube Delta), and a little sedimentology (Morava and West Water).

Social and economic impacts have been observed and described for almost all projects, but no real monitoring effort has been set up, and no structure such as the use of questionnaires were available to cover this aspect of monitoring. The Danube Delta seems to be the only project in a position to refer to figures of the impact on the social and possibly economic impact of the restoration.

Table 3.3: Monitoring structure of selected WWF river restoration projects (S= survey; M=monitoring; (M)=incomplete monitoring)

	Morava (SL)	Morava (A)	Regelsbrunner Au	Rastatter Aue	Kühkopf	Bislicher Insel	Ringfurth	Wümme	Gelderse Poort	Biebrza	Danube Delta	West Water
Hydrology												
River	M	M	M	M	?	M	?	M	M	M	M	S
Ground water table			?	M		S			?	M	M	S
Chemistry								S	?	M	M	S
Geology												
Soils						S		S	S	M	S	
Sediments	M	M										
Social impact											M	
Economic impact											M	
Species - group												
Trees			M	M	M						M	
Tree rings				M	?							M
Terrestrial vegetation	?		M	S	M	M		M	M	(M)	M	M
Aquatic vegetation	M		M		M	M		M			M	M
Mammals			M		?						M	
Birds	M		M	S	S	M	?	M	M		M	M
Reptiles											?	
Amphibians			M	S		S		S			?	
Fish	M	M	M			S		M	S		M	M
Butterflies			M		?	S		S	S		M	S
Moths						S		S	S		?	
Caddisflies								S			?	S
Carabid Beetles				S	?	S		M	S		M	S
Rove Beetles								S				
Water Beetles								S				
Hoverflies					?							
Other Diptera												
Bumble Bees												S
Water bugs								S				
Cicadina								S				
Orthoptera						S		S	S		S	
Plecoptera								S				S
Odonata			M	S		S	M	M	S		M	S
Ephemeroptera								S				S
Arachnidae					?			S			M	
Isopoda												
Mollusca						S			S			S

3.5 Successes

There have been a considerable number of often-unexpected successes and the most striking result is the speed with which some of the projected changes have been achieved. Particularly in the Danube Delta, but also at the Wümme and in the Gelderse Poort, results have been shown quickly. Subsequently, some people expressed concern about publicising this too widely as it might give those who destroy river systems, an excuse to carry on doing so. But this concern might be flawed in an environment of a broad and growing platform of interest in river restoration, including industry and stakeholders.

Table 3.4: Major results in selected WWF river restoration projects

Result	Description	Case study sites	
		Successful	Less successful
Natural processes	Development of natural bio-geomorphologic river structures, such as sand banks, river cliffs and initial plant growth	Gelderse Poort West Water Wümme	
Retention and Flood control	Increase of retention area and cut off of the flood peaks by leading water through largely vegetated areas	Gelderse Poort Danube Delta Rastatter Aue Regelsbrunner Au	Bislicher Insel
Water table increase	Increase of water table by counteracting the drainage system of the river floodplain	Biebrza (considerable increase only for a few months; further steps to ensure long-term success are planned) Danube Delta (opening of dikes) Regelsbrunner Au (opening of dikes) Rastatter Aue (re-connecting of side rivers)	
Water purification	Measured decrease in nitrate and phosphate	Biebrza Danube Delta	
Regeneration of Vegetation	Reed belts re-growing after grazing removed; aquatic flora restored after opening of dikes	Bislicher Insel Danube Delta	Wümme (loss of original valuable veg.)
Land use change	Successful transformation of farmland into natural riverine habitats	Gelderse Poort Bislicher Insel Wümme Danube Delta	Biebrza (conflict of interest only recently addressed)
New species (Increased or established characteristic biodiversity)	Key species or unexpected new species, which have become established due to the restoration activities	Wümme (otter, kingfisher, dragonflies, beetles) Gelderse Poort (e.g. corncrake, otter), Bislicher Insel (cormorant colony), Danube Delta (beetles, reed plants, fish breeding grounds and birds)	
Re-introduced species	Re-introducing formerly native species in combination with restoration works	Gelderse Poort (beaver) Rastatter Aue (elm tree saplings)	
Unexpected results			
New species		Gelderse Poort (e.g. corncrake, otter), Bislicher Insel (cormorant colony), Morava (White-tailed Eagle), Wümme (plant species)	
Flood resistance of oak trees	Ten years of WWF studies show that oak trees survive flooding longer than admitted by science or expected.	Rastatter Aue	
Dutch elm disease resistance (?)	There is slight evidence that elm trees might be resistant when growing in their natural hardwood floodplain forest habitat	Kühkopf Rastatter Aue	

- Natural processes**

The results at three projects with significant hydrological alteration have demonstrated the power and speed of potential change. It is necessary to open the floodplain completely to allow the river and floodplain to “breathe” again. These conditions have been set up at the Danube Delta by opening the existing dams and at the Regelsbrunner Au also by opening the dams entirely. At the Wümme the

dismantling of any dikes encouraged the river dynamics to create a new river bank morphology. Those expecting these changes to become stabilised might have been disappointed because the natural processes that were creating a new river bank are ongoing, and desired changes may sometimes eventually turn into unwanted changes, as seen in the Wümme project. Here the sandbanks and mudflats changed again or became overgrown. This was observed particularly on small rivers, such as the Wümme, but these changes are also obvious at the West Water. Here, sand and gravel banks developed and tiny saplings appeared. It needs to be awaited to see if there are any changes in the large-scaled floodplains of the Rhine and Danube. The first signs of the desired dynamic natural processes though, have been noticed along the River Rhine at Gelderse Poort. The extremely high floods in the Regelsbrunner Au in spring 1999 might bring some significant changes.

The introduction of large herbivores, such as the Konik ponies, Galloway cattle and other old breeds have been a successful measure for management without interfering too much in the natural succession. These half-wild cattle and horse breeds have been successfully established along the Rhine floodplain and in the Wümme project, creating a heterogeneous and more naturally-structured habitat, which still allow for natural succession (see Stichting Ark 1999).

On the River Wümme it has paid off well for the WWF project to start the restoration on a small river stretch and continue along the river using the experiences from the first steps. In the first years after restoration at the Wümme it became obvious, that the excellent sand banks and mudflats in the river bed gradually changed into a climax situation and that there was no longer space for these important freshwater habitats. Large-scale river restoration along several kilometres of river will naturally create the one or the other situation on the river, but along a 500 metre stretch there is no space (Wümme). There was a lot of discussion in the Wümme project and many demanded that nature conservation bodies and WWF should interfere and remove the vegetation, which eventually was not agreed upon. Before the situation could develop satisfactorily for everybody, an interim solution seems to be the gradual extension of new restoration works creating new pioneer situations along the river. Although being aware that this is not an ideal situation, it does help to overcome interim lack of sufficient habitat structures for freshwater species dependent on primary succession stages. Apparently on the Wümme, plant species believed to be extinct in the area, re-established themselves in those areas from which the upper soil layers had been freshly removed.

The Regelsbrunner Au project is designed in a similar way although on a large scale for a larger river. From the first steps on approximately 500 ha the restoration will be extended at a later stage to the entire National Park and beyond, using the experiences at Regelsbrunn. Another advantage of starting on a small scale and gradually extending the restoration to adjacent areas, lies in the variety of habitats created that way.

- **Flood defense**

It is doubtful whether the increased area of retention already has an effect on flood defense in these case studies. This is only expected if larger areas are included into the extension of the river's narrow bed. Conversely, there was no evidence of increased flooding of properties as a result of river restoration. The projects reviewed here only considered small areas, which would be unlikely to have an effect on the overall flooding regime of each river.

- **Floodplain forest restoration**

There is growing evidence to suggest that the resistance of some elm trees is related to the growth of elms in natural or semi-natural conditions in floodplain forests, as observations in the Rastatter Aue, the Kühkopf-Knoblauchsau (not reviewed in this study) and the Morava floodplain forest indicate. Although there are uncertainties, genetic modification techniques might preserve some trees, but it is still not certain whether they would survive under unnatural conditions. River restoration, by providing natural floodplain forests, seems to be a more appropriate way forward and additionally serves multifunctional purposes. Many tree species develop a stronger resistance against diseases and the tree population becomes more viable, as long-term observations in the Morava and Rastatter floodplain have demonstrated.

There are only around 7,000 individuals of Black Poplar left in the U.K. and conservationists feared it would have died out by the end of the next decade. The destruction of the poplar's riverbank habitat has been largely recognised as the cause of this decline across Europe. Genetic modification might enable more disease-resistant hybrid trees to be planted, but restoring its habitat again seems to be a better, more comprehensive response to the problem. The Gelderse Poort, Bislicher Insel, Danube Delta, Rastatter Aue and other projects already indicate the potential of regenerating Black Poplars on European rivers and no GM technology (with its potential dangers) is needed.

- **Floodplain restoration from arable land**

There have been two different ways of converting maize crops into natural vegetation. One area at the Bislicher Insel project has been converted with support of additional planting of grass seeds, the other adjacent area has been set aside without any additional seeding. Surprisingly, the latter grew better and further projects trying to convert maize crops should take these experiences into account.

- **Introduced species**

Among the reviewed projects, animal species have only been introduced in the Gelderse Poort area. The beaver project, after initial difficulties, has been successful because the habitat conditions for the animals have improved. Only when the habitat requirements of the species have been developed, can the introduction of a species be successful. Some areas have not even been colonised by this species before, or connected with neighboring populations. Often project managers should remain patient and should resist the pressure of those who want to introduce popular species for the sake of publicity. Many species will naturally re-establish populations in the area.

- **Social benefits**

The social benefits of river restoration are numerous. Most obvious to all local communities were the advantages deriving from the additional income from tourism (Morava, Gelderse Poort, partly Wümme and potentially in the Biebrza). Also, the fishing communities and recreational anglers increasingly recognised the advantages of a healthy floodplain for sustainable use of freshwater fish (Danube Delta, Regelsbrunner Au and West Water). Generally, the long-term benefits from river restoration for flood control and the reduction of flood peaks have not been widely recognised. This is mainly because many of the desired effects have not been visible, partly because they have only been carried out on a small scale and will only show effect once they are embedded into the context of the entire floodplain.

3.6 Major Constraints

River restoration at the moment seems to be well recognised as a priority action for nature conservation and it is gaining recognition by other sectors, such as flood defence. The time has never been so favourable to promote river and floodplain restoration. But still careful planning and preparations are required, not only to accomplish the needs of different stakeholders but also to agree on a common vision among conservationists and planners to avoid misunderstanding and potential conflict in the future.

- **Hydrology**

Having gained experiences from some projects, it has been demonstrated that in order to be successful in achieving the anticipated and desired changes in the hydrology, full commitment from the outset is required. This need for full commitment can be seen by observing restoration projects that have reluctantly implemented measures to improve the hydrological situation, e.g. out of fear or insecurity (Biebrza) or to a lack of decent planning (Morava (SL)) that either had no effects or even caused more problems. Effective compromises in hydrological restoration are hard to achieve (e.g. Biebrza). However, unless the entire river is under the scope of the restoration, compromises between the restoration objectives and farming have to be made. The 'all or nothing' approach towards reaching hydrological targets is more achievable as it may avoid the need for extensive consultation and speculation on the likely impacts of various options. (Danube Delta, Regelsbrunner Au). The Danube Delta project provides a good example of careful planning. At first, a fair amount of investigation is necessary to explore the often complex hydrological situation. This is true not only for large river

systems, but also for smaller ones too. Secondly the planning should outline the exact location and the timing for the activities.

Projects still with a high proportion of agricultural land use may require the retention of certain dams or weirs as barriers in the river to maintain acceptable water levels in the adjacent floodplain (Wümme).

- **Forestry**

Floodplain forests are a major issue for conservation in Europe. Three of the projects evaluated have forest restoration as their major objective. The Rastatter Aue project is one of the oldest WWF projects in Europe and certainly can look back over a long history of experiences. The reluctant but active replanting shows excellent results. The area is not in the hands of WWF and careful negotiating was necessary to implement the planting management. Unfortunately the unique opportunity of monitoring the forest restoration has been restricted to the tree development only. In Regelsbrunn, only initial cutting of holes in the hybrid poplar stands has been undertaken. Now only natural succession shall re-establish the new forest. No hunting at all is allowed. In the Morava area, planting and sustainable forestry are dominating and natural succession is restricted to selected areas only. Hunting of deer is permitted, to control natural forest succession. Both the latter projects still lack enough experiences to extract general knowledge of how to deal with forested areas and hunting in large floodplains. Other project areas along the Danube in Hungary and along the river Elbe and Oder might provide additional experiences, which should be evaluated in another context.

- **Natural dynamics and sustainable use**

The experiences from the Wümme and Biebrza projects, demonstrate the significance of this issue for nature conservation, and to WWF in particular. Both projects nicely mirror the situation among conservationists all over Europe, with a growing perception for allowing and protecting natural processes, which is sometimes in conflict with the concept of the sustainable use of wetlands. The sustainability of land use practices, such as in the extensive grazing in the floodplain, is not the issue. Conflicts arise when land use in the floodplain requires water controls and management, which restricts the possibilities of natural dynamics. Conversely, certain types of harvesting in the floodplain (e.g. timber, willow bushes, reeds or animals) can still be undertaken in the framework of the natural dynamics of the river. A solution has to be seen in the context of each project (e.g. Wümme and Biebrza). A general demand for natural succession everywhere is not applicable.

Natural succession and the development of large forest areas, where there has formerly been flat, grazed, open floodplain, can also cause a problem for water discharge. Although it can cut off the major peaks of the floods, there is growing concern for flood control. Apart from smaller rivers, where the succession in the floodplain does have a damming effect (Wümme), similar observations for larger rivers have not been confirmed.

- **Lack of communication**

Another important constraint is the lack of communication between different river restoration projects in order to exchange experiences. This has been partly achieved on a local scale and has only recently been improved on a larger scale due to the set up of a European WWF Freshwater Programme and the European Centre for River Restoration, which has this technical exchange as a main priority.

- **Differences in culture and the legal framework**

Due to the previous emphasis on melioration and regulation, the legal and administrative framework is often non-transparent and complicated, with many responsibilities widely distributed over many different authorities. In Austria and Germany for example, the legal framework, the water law and the federal structure are regionalised, with different federal state laws. It does offer opportunities, but also puts constraints on river restoration. On the other hand, in The Netherlands, an overall plan (such as the Ooievaar) provides the context for local projects, still in the legal responsibility of the local authority, as demonstrated in the Millinger Waard in the Gelderse Poort project. It was especially helpful in the Wümmewiesen project to have one administrative unit responsible for the entire restoration process, directing all the authorities involved in the restoration.

In Eastern Europe, the crash of the old administration has provided opportunities as well as constraints. There is a widespread open mindset for radical changes and large-scale projects such as the Danube Delta restoration and the Biebrza floodplain restoration. On the other hand, responsibilities are often unclear and there is a general lack of funding that requires international support, which often is not sufficiently available for complete implementation.

- **EU policy**

The framework of European agricultural policy is still in favour of intensive land use in floodplains, which puts a large constraint on the restoration of private land. This is also contrary to the Agenda 21, which supports local sustainable development in floodplains where possible. This is partly responsible for the failures and constraints in the Bislicher Insel project in Germany and for the decision to exclude further agriculture land use in the Gelderse Poort project in The Netherlands.

3.7 Acceptance

With each extreme flood event - and they seem to have increased in recent years - the need for the "wise use" of rivers becomes more evident. There is a growing perception of rivers becoming too narrow to cope with the increasing amount of water flowing downstream at times. Continuing to build higher dykes and using the adjacent floodplain intensively no longer seems to be an adequate response in the face of increasing flooding frequencies. In principle the acceptance of river restoration projects has largely increased, which also has been mirrored in political decisions in favour of river restoration, of which the Gelderse Poort and the Ooievaar plan is the best case study. Increasingly the experiences have been taken up by more and more water authorities, where a new thinking slowly replaces the traditional way of treating rivers. But, the fact that there still seems to be a long way to go, is demonstrated by the interview given in the 'Süddeutsche Zeitung' on May 25th 1999 by the head of the Bavarian water authority. His response to the spring flooding in Bavaria did not show any rethinking, but was to enforce all conventional measures. He requested further funding from the state to continue river regulation and dyke enforcement rather than testing new approaches, and in this way not escaping the viscous circle of destruction, only prolonging it.

When it comes to action at the site, the local population often still seems to be reluctant. The acceptance of local communities varies considerably, ranging from total acceptance in the Danube Delta, more reluctant acceptance in Regelsbrunn and most others, to rather sceptical tolerance (Biebrza, Wümme and Bislicher Insel).

The link between biodiversity and a healthy environment has not been fully understood by many people. It certainly helps when local communities can identify themselves with the area and the restoration objectives, for example, choosing charismatic species, such as the White Stork (Morava), or alternatively when restoration activities go in line with the economic benefits e.g. to fish stocks and reed stands as in the Danube Delta.

3.8 Costs and Benefits

The costs of river restoration are variable, but can be quite significant. They range from approximately 75,000 Euro at the West Water demonstration site, to 250-300,000 Euro for about 6 ha at the Wümme (excluding personnel costs and land purchase), and 20 million shillings (=1.4 million Euro) for just the construction works at the Regelsbrunner Au. Restoration costs still seem to form the major constraint for the implementation of many projects, often because the economic benefits as well as the ecological ones are not easily recognised.

Unfortunately information on the costs of the projects is very incomplete and no project could provide full information, which would enable an accurate cost benefit analysis. The benefits can be ecological, but also social and of an economic nature. Many benefits will only show results after a longer period and can not be assessed now, as the majority of the projects have only started implementation recently. Additionally, benefits occur elsewhere, beyond the restoration site itself, and are hardly measurable (North Sea, Black Sea). Table 3.5 shows the costs and benefits of river restoration in its total scope without assessing the actual costs.

Table 3.5: Costs and benefits (soc = social; econ = economic; ecol = ecological) from selected European river restoration projects

Costs	Benefits
Land purchase	Flood control (soc/ econ)
Construction works	Less dyke maintenance (econ)
Compensation for stakeholders	Increase of habitat structure for biodiversity (ecol)
Monitoring	Water purification (soc/econ/ecol)
Project management and administration costs (including communication)	Natural sedimentation and deposition (ecol)
Public awareness work and publicity	Nitrate and Phosphate accumulation (econ/ecol)
	Increase in fish yields, fish broods (soc/econ/ecol)
	Recreation (soc/econ)

3.9 Funding

River restoration can be very expensive. Restoration of comparatively small stretches of large rivers can cost several million Euro (Regelsbrunner Au). A proper funding system is crucial. In Table 3.6 the different schemes used to fund the case study projects have been listed.

Table 3.6: Funding schemes in selected European river restoration projects

Funding scheme	Case study sites
GEF World Bank	Danube Delta, Morava (SL)
LIFE, PHARE, TACIS (other EU programmes)	Danube Delta, Morava (A, SL),
EAGGF	West Water Demonstration Site
National governmental funds	Danube Delta, Regelsbrunner Au, Rastatter Aue, Gelderse Poort, Bislicher Insel, Wümme, Biebrza
Regional support	Rastatter Aue, Gelderse Poort, Bislicher Insel, Wümme
Commercial Sponsoring	Gelderse Poort, Cap de Terme
WWF (- =little; += larger support)	Danube Delta (+); Wümme (+), West Water (-), Biebrza (+)

GEF funds from the World Bank, and PHARE and TACIS funds from the EU, are only applicable for developing countries and countries in transition (e.g. in Eastern Europe). For projects in member states in the EU, the LIFE programme seems to be the most appropriate funding programme. Projects do need to raise 50% of the restoration costs from other sources to complement the funding. For special agricultural, so called 'Objective 5b areas' in the European Union, other EU funding schemes can be chosen to apply for funding. As an example among many funding schemes under the EU whose focus differs widely, following a successful application to the European Agricultural Guidance and Guarantee Funds (EAGGF) for the restoration at the West Water and other demonstration sites in Scotland, WWF contributed 50% of the total costs.

The Lower Danube Green Corridor under the 'Gift to the Earth' initiative of WWF budgeted 35 million US dollars to cover all WWF's project proposals in the region. The ambitious plan is supported by the EU PHARE and TACIS funds, the WWF Partners for the Wetlands initiative, the GEF and also Austrian and Danish funding schemes. The WWF Partners for Wetlands initiative involves a funding commitment from WWF of approximately US\$ 1.5 million over a three year period beginning on August 1st, 1998. These funds will be used to carry out the projects along the Danube in Ukraine, as part of one of four world-wide WWF wetland projects, including investments and grants to support restoration, wetland conservation, economic activities in support of wetland conservation and restoration, and project administration and communication. It is expected and hoped,

however, that this funding commitment will be magnified and expanded through additional contributions from Ukrainian and international sources over the five year period of 1998 to 2002.

WWF has financed very little directly, nor financially supported the river restoration projects. They often focussed on the land purchase and provided their expertise and capacity building, assisted or even financed the monitoring (Danube Delta, Wümme and West Water) and raised public awareness, which altogether is highly cost intensive.

3.10 Role of WWF

WWF's role in the case study projects varies considerably, with different levels of involvement and commitment. In the Bislicher Insel, WWF functioned as an initiator and in the Gelderse Poort and Biebrza projects mainly as catalyst and mediator between all the actors. The actual involvement in the management of the restoration projects varies from low key to fully committed management of the restoration projects (Wümme, Regelsbrunner Au, Danube Delta). The degree of commitment is often determined by various external factors, such as political support, the legal and administrative framework and the staff time and funding available. But, the decision process for the involvement of WWF is not always clear and consistent, which is also responsible for the varying degree of commitment and consequently the differing levels of success of the projects.

4. Summary of issues to consider in planning river restoration projects

This chapter provides a summary of all the important steps for planning a successful restoration project based of the reviewed case studies. As this is only a small sample of many projects carried out all over Europe the recommendations cover only those aspects which have been mentioned in the case studies. But these widely cover a complete range of the experiences and regions. An idealistic framework for river restoration planning (Figure 4.1) can be drawn from the chosen case studies and applied for almost all regions in Europe.

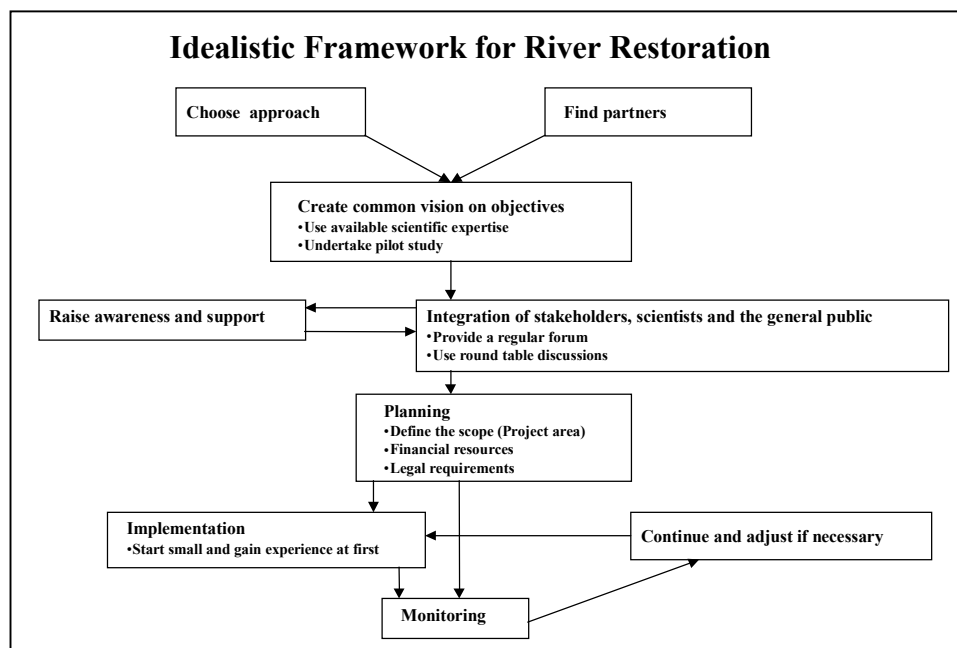


Figure 4.1: Idealistic framework for planning river restoration

Choice of approach

WWF or the organisation that decides to plan and implement a river restoration project, should agree on a common vision with partners.

Develop partnership/agree on common objectives and lead organisation

The appropriate partners will share the burden, duties and benefits of the project with WWF. Partners can traditionally be the regional or local authorities or stakeholders, who share a common interest in the restoration. More and more projects involve industries as partners, either directly like the clay industry in the Gelderse Poort or indirectly in financial or logistic commitment (Cap de Terme, Wümme).

- **Raise awareness and support**

When no partner seems to be attracted to the project, but the organisation is convinced of the benefits of the restoration, publicity is an important means to raise awareness about the project and to gain financial and political support. In this respect, key species such as otter, beaver, kingfisher (Regelsbrunner Au) or storks (Morava) serve as effective incentives and are valuable for raising awareness and public support.

Define the scope

- **Project area:**

Often a project is limited in size by constraints due to different landowners or any factual situation at the site, which can not be altered. But it is worthwhile finding out the ideal ecological need for space for the restoration in the absence of any constraints, to serve as a starting point for discussions. The demand of space varies for each river depending on type and size. A method to calculate and estimate the demand on the space for each river has been developed by Heeb et al. (1999). For Austria they came to the conclusion that an additional demand of about 1 % of the total area of the country would ideally be required.

- **Start on smaller river stretches, gain experiences and continue along the river as funding and political support allow**

Each river is a complex system of many uncountable and intangible factors. Each river will respond differently, and we can only predict a certain amount due to size, type, environment, discharge and other components in the context of the entire catchment. It is therefore strongly advised to start on a small section of the projected restoration area to gain experiences and to then extend with the collected knowledge outwards from the first restoration steps to the entire area (see Wümme).

- **Integration of all players**

The involvement of all stakeholders will be necessary. However, it is advisable to create different levels of participation. Special working groups should be established to deal specifically with particular issues, such as fishing, farming or other issues relevant for particular stakeholders. Again other working groups should provide a forum for all groups and persons interested in biodiversity, to express their particular interest and vision for the restoration. Of special value were regular round table discussions, such as those organised by WWF in the Regelsbrunner Au project.

- **Communication and sharing of experiences**

It has been demonstrated how useful exchanges between the various projects can be. An actual visit to the site can be extremely useful in gaining deeper insights into the problems and constraints, the approaches and successes. These experiences can then be compared with the home project and this may well lead to updating the strategy and management of that project.

- **Planning**

Various management plans outline the restoration targets, but also possible constraints with stakeholders. Alongside the ecological features, studies on the social and economic aspects of the restoration have been undertaken (e.g. Biebrza). When hydrological changes are involved, careful planning is essential to achieve successful restoration, as has been demonstrated at the Danube Delta and Biebrza project. At first, a fair amount of investigation is necessary to explore the often-complex hydrological situation, which is true for both large and small river systems. Secondly, the planning should cover the exact location and the timing of the activities. Depending on the country and the region, different legal requirements are necessary and part of the planning stage, often years before the implementation can begin. The legal framework ranges from simple decrees, involving only the legal authority (Wümme), to long lasting legal procedures with legally binding participation of stakeholders and all relevant authorities. These often include different levels of administration, which all might have an interest other than in the restoration itself, which may extend the planning phase considerably (e.g. Bislicher Insel).

- **Choose the appropriate monitoring**

As mentioned earlier in the text, an appropriate monitoring set up is essential in order to be able to follow up on the successes of the project. It seems obvious to implement a hydrological monitoring scheme, which covers the water tables of the river as well as ground water tables in the floodplain. This is particularly true in restoring rivers and initiating highly dynamic processes with unknown and unexpected developments. To measure natural processes it is important to include the sediments and other deposits into the monitoring. Table 4.1 will give some guidance to help choose the right parameter for a biodiversity monitoring set-up, for those designing a monitoring programme with sufficient background information. This will help establish an appropriate monitoring system that is

suitable for the objectives, activities implemented and the funding available. Hydrology, and when appropriate, sedimentology, should be compulsory in any monitoring scheme. The specific set up depends on the project goals. Last, but not least, a monitoring programme should also cover social and economic aspects, which often have not been properly implemented, and hence the experiences and successes were not well documented.

It is also important to stress that any monitoring has to start before the implementation. A guarantee of follow up monitoring of the development of the project during and after restoration should also be secure, and budgeted for a long period e.g. for at least twenty years, depending on the objectives, with intervals to allow for appropriate adjustments.

Vegetation and birds seem to be the obvious groups and most easy to achieve assessment in a monitoring scheme. They should not be missed out from any monitoring scheme. Naturally, fish and possibly dragonflies as obvious aquatic and semi-aquatic groups reflect the hydrological changes, and monitoring of these groups can be undertaken without too much effort. High total abundance and diversity of spiders and Carabid beetles reflects the importance of river and wetlands for higher level predators in many projects. This illustrates that the riparian habitats show the highest population density. These taxa are very suitable for monitoring the river restoration in terms of the natural processes, but their monitoring is expensive and time consuming, with still only a few specialists available to monitor these species. The same applies for the molluscs, which according to Table 4.1 have an important value for monitoring, but have not been included in detail by most of the investigated case study sites.

Table 4.1: Idealistic monitoring programme of biodiversity for river restoration reflecting the major habitats and restoration objectives, with reference to Spang (1992) and Handke (1999); H: highly, M: middle, L: little, ? unknown usage for monitoring purposes.

Species Group	Restoration Objectives						
	Flooding/wetter conditions	Fallow ground	Retention	Sound land use	Natural river dynamics	New ponds	Forest succession
Plants/Animals							
Trees	H	L	M		H		H
Terrestrial vegetation	H	H	H	H			H
Aquatic vegetation			M		H	H	
Mammals	M	M	M		L		H
Birds	M	M	M	H	L	L	H
Reptiles	?	L		H	L		
Amphibians	M	M	H		H	H	L
Fish					H	H	
Butterflies	?	H			L		H
Moths	H	H			M		H
Caddisflies					H	H	
Carabid Beetles	H	H	H	L	H	H	?
Rove Beetles	?	H	H	?			?
Water Beetles						H	
Hoverflies	H	M	M	H	L	H	H
Other Diptera	?	?	?	?	?	?	H
Bumble Bees			M		L		L
Water bugs					L	H	
Cicadina	M	M	M				M
Orthoptera	H	H	M	M			L
Plecoptera					H		
Odonata	M				H	H	L
Ephemeroptera					H	H	
Arachnidae	H	H	H		H	H	H
Isopoda	M				?		H
Mollusca	H	H	H	M	H	H	H
Lumbricidae	H	H	H	M	M		?

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References

Dister, E. (1991): Hochwasserschutz durch Auenrenaturierung am Oberrhein/Bescherming tegen overstromingen door revitalisering van ooigebieden aan de Bovenrijn. WWF Tagungsband 5: 152-177.

Eichelmann, U. The book of Austrian rivers. Vienna 66 pp.

Handke, K. (1999): Zoologische Untersuchungen in den Wümmewiesen 1981 bis 1998 - ein Überblick mit Empfehlungen für künftige Erfolgskontrollen. Unpub. Report for WWF Germany.

Heeb, J., Huber, F. & Willmann, I. (1999): Mehr Platz für Österreichs Flüsse. Minimaler Raumbedarf "Fließgewässernetz Österreich" WWF Studie 36. 36pp.

ICDD, WWF- Auen -Institute (1997): Ecological restoration in the Danube Delta Biosphere/ Romania. 120 pp.

Spang, W.D. (1992): Methoden und Auswahl faunistischer Indikatoren im Rahmen raumrelevanter Planungen. Natur u. Landschaft 67: 158-161.

Stichting Ark (1999): Natural Grazing. Hoog Keppel. 61 pages.